VOL. 36, NO. 9 SEPTEMBER, 1959

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Published Monthly by the AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION,
1508 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

ANNUAL SUBSCRIPTION, UNITED STATES and CANADA $8.00; FOREIGN $9.00.
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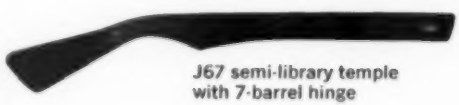

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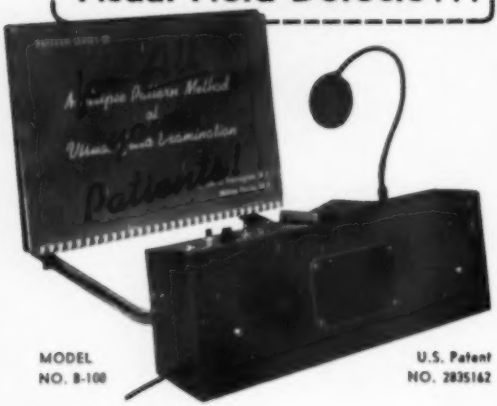

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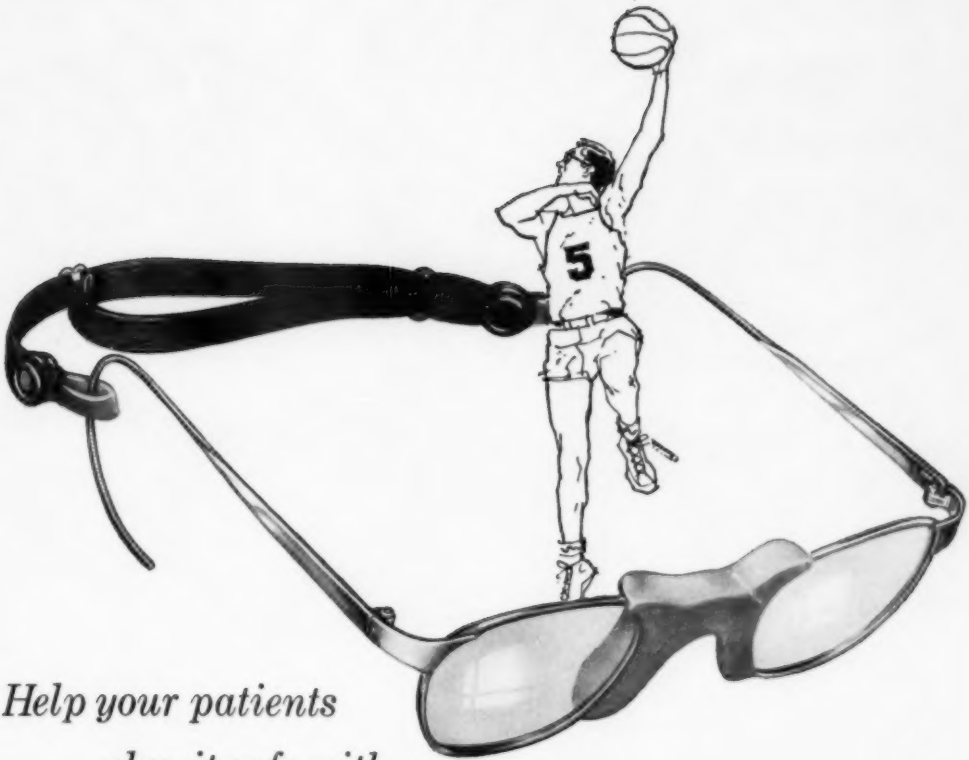

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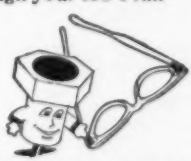

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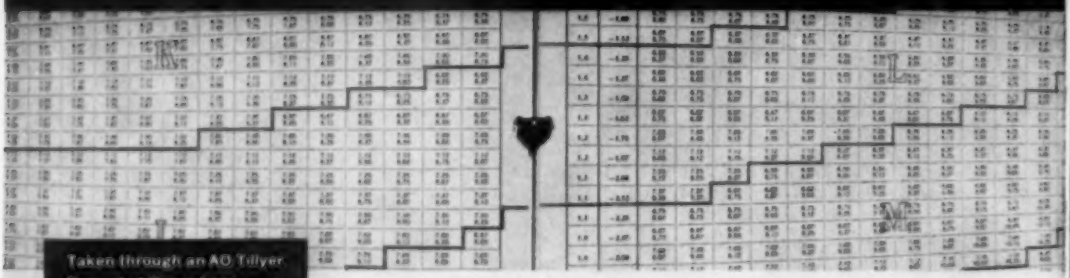

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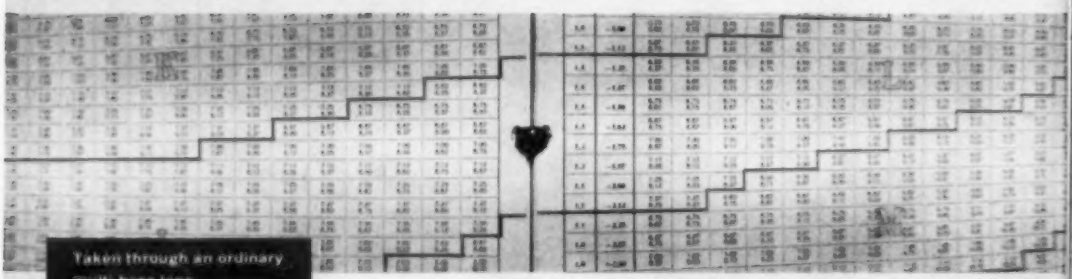

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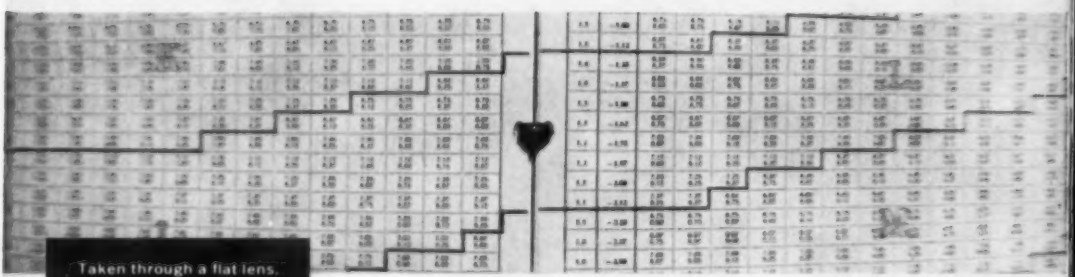

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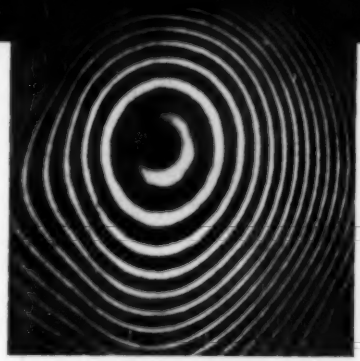

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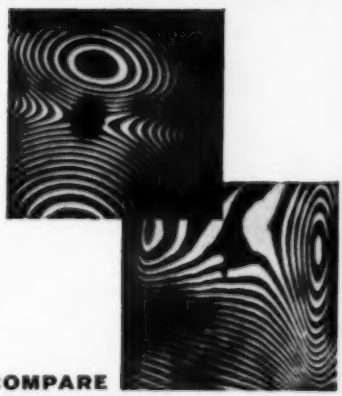

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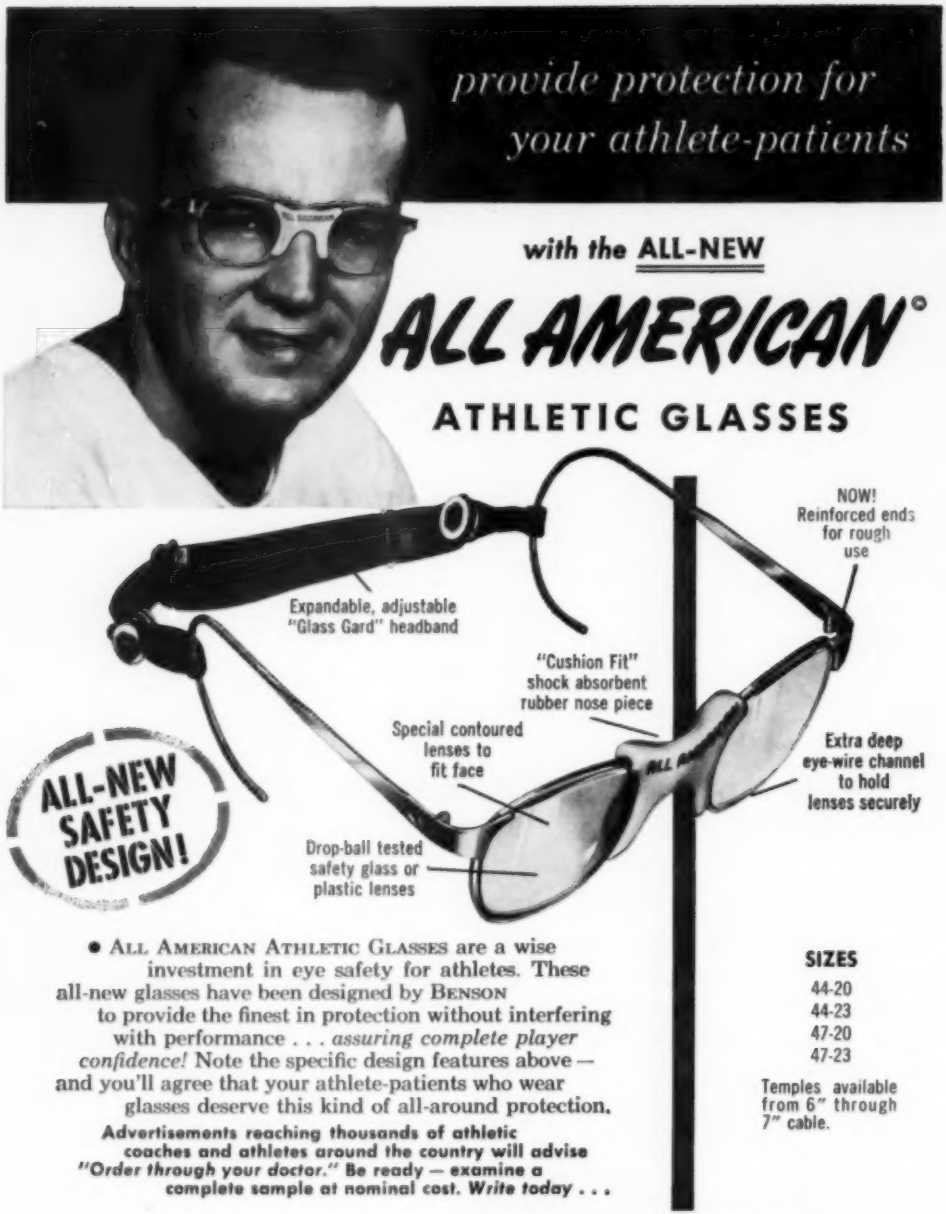
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AMERICAN JOURNAL OF OPTOMETRY
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Vol. 36 September, 1959 No. 9

# THE ORINDA VISION STUDY*

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School of Medicine, Stanford University
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## INTRODUCTION

The importance of good vision to the optimal development and education of all children is widely recognized by laws requiring periodic vision testing of school children. Such a law exists in California and requires the governing board of each district to provide adequate vision tests for each pupil enrolled in the schools of the district. The law does not define an adequate test nor does it specify the frequency of such tests.

The Superintendent of Contra Costa County Department of Education, faced with the problem of providing the vision testing, asked the Health Department for recommendations. Although the Health Department has only very limited legal responsibilities (communicable diseases and sanitation) for school health, it does make every effort to promote and stimulate good health practices for the 100,000 students in 34 autonomous school districts. It provides consultation to schools

*Read before the annual meeting of the American Academy of Optometry, Boston, Massachusetts, December 13, 1958. For publication in the September, 1959, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

Reported under title "Investigation to Design and Evaluate a Vision Screening Program for Elementary School Children" by Henrik L. Blum to the Epidemiology, Health Officer and Statistics Section, American Public Health Association, St. Louis, October 28, 1958. Complete report under title "Vision Screening for Elementary Schools: The Orinda Study" Blum, Peters, Bettman being published by the University of California Press.

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‡M.D., Professor of Surgery (Ophthalmology).

**Optometrist, Clinical Instructor of Optometry.

‡‡M.D., Clinical Instructor of Surgery (Ophthalmology).

in all areas of health including curriculum, school health practices, examinations, records, and so forth, for all schools requesting such services. All but the smallest schools in the county provide their own school nursing services.

The Health Department soon discovered the lack of tangible and satisfactory screening methods, the intra and inter eye professional disagreements and the near impossibility of suggesting procedures that could be regarded as proven satisfactory to do an adequate job. Existing recommendations in California[1] represented a committee compromise reached by various interests, including ophthalmologists, optometrists and educators. This tended to focus on the methods, limited as they might be, on which reasonable agreement could be reached with hopes for a minimum of over-referrals and on the theoretical teaching value of teacher administered tests.

Since members of the Contra Costa County Health Department are on the faculties of both the University of California, Berkeley (where there is a School of Optometry) and Stanford University School of Medicine (where there is a Department of Ophthalmology) and, as an agency, serves as consultant to schools, it utilized its unique position to bring all groups together to study this problem.

A study staff was organized composed of the County Health Officer, two ophthalmologists from the Stanford faculty and two optometrists from the University of California faculty. This was supplemented by other interested representatives of education, public health and parents groups.

The purpose of this group was to develop a vision screening program that (1) could be achieved in an average community and school system; (2) would find essentially all children with significant eye problems that most ophthalmologists and optometrists would agree needed to be under professional care, whether therapy was to be recommended or not; (3) would avoid or minimize a conflict of opinion in each professional group or between the eye professions, or between the schools and the eye professions; (4) would minimize the over-referral problem with its attendant costs and complaints.

A review of the available literature indicated shortcomings in most of the researches reported. Many studies reported only the number of children failing various screening methods. Some attempted to evaluate these screening failures with clinical examinations. A few attempted to find, by means of clinical examinations, all the children in the sample population who should have professional attention and to measure the screening efficiency against this standard. Unfortunately

the clinical criteria are not always given and screening efficiency was found to be rather poor. There is reported in the literature little or no effort to bring the two eye care professions together on this matter.

The St. Louis Study,[2] the Toronto Study,[3] the North Carolina Study,[4] the Shrewsbury Study,[5] the Danbury Study,[6] the Columbus Study,[7] and the Andover Study,[8] all contain some of these shortcomings. None of them indicates a clear approach to the efficient vision screening of the children nor an interprofessionally accepted set of screening standards. A new research effort was clearly indicated.

## DESIGN OF THE ORINDA STUDY

Screening was performed on more than 1,000 children enrolled in grades one through six in the Orinda School District in 1954. Each technique was administered in such a way, and by personnel so trained as to approximate a probable, usual administration of each method in a typical school situation. Clinical examinations were made on children failing any one of the screening tests. They were also done on a control group composed of one-fifth of the children selected randomly by the school administration. The clinical examinations were done separately by optometrists at the University of California, School of Optometry, and ophthalmologists at Stanford University, School of Medicine. Determination of the need for professional attention, regardless of therapy, was made jointly by the study staff from the combined examination reports. These in turn served as a basis for determining specific, clinical criteria which were then adopted for the succeeding two years when the same pattern of screening and examination of all the children was repeated. The entire control group was given a repeat clinical examination in 1956.

Screening methods included: (1) Parent questionnaire or symptom inventory, 1954 and modified in 1956. (2) Teacher observation each year after a six-hour training course given by ophthalmologists and optometrists. (3) Nurse observation each year. (4) California state recommended procedures, with the teacher testing visual acuity with the Snellen illiterate E, and repeated through a +1.50 and +2.00 D.S. 1954 and 1955. The cover test was abandoned after the first year. The nurse retested all failures before classifying them as referrals. Nurses did both test and retest in 1956. (5) The Massachusetts Vision Kit (MVK) test was administered by a trained nurse in 1954, and in 1956 a second failure by a second trained nurse was required before a child was classified as needing referral. (6) Telebinocular test was administered in 1955 and 1956 as the MVK above, including all tests except 8, 9, 12, 13 and 14. (7) The Worth Four Dot Test was done only

in 1955. (8) The Modified Clinical Technique (MCT), as described in the appendix, was administered by optometrists each year. Some modifications of screening were introduced in 1955 and 1956.

All screening tests were made on an "as is" basis, that is, with present spectacles if worn. The clinical evaluations for those wearing spectacles compared the clinical findings to the prescription of the spectacles being worn.

A supplementary study was done to compare the clinical criteria of this study to professional opinion in the United States. A questionnaire was developed and sent to 630 members of the American Academy of Optometry, to 260 members of the Pacific Coast Oto-ophthalmological Society, and to 240 members of the American Academy of Ophthalmology, with nearly half of the total group responding.

## ANALYSIS AND SUMMARY OF FINDINGS

### CLINICAL CRITERIA

By agreement based on their respective complete clinical examinations, the study staff decided which children should have been referred for professional vision attention in 1954 (correct-referrals) and which should not (unnecessary referrals). An intensive investigation was made to reduce the clinical decisions of the optometrists and ophthalmologists to the simplest possible terms. The clinical criteria, including limits, were established by a unique graphical method[9] for four variables that were shown to be relatively independent. All four of these criteria, but no others, were necessary to separate the correct-referrals from the unnecessary-referrals. No variation in the criteria or the limits was found to be necessary to make this separation at the various age levels nor for either sex. These criteria and appropriate limits are shown in Table I. These were used without modification in 1955 and 1956.

The results of the inter-professional screening questionnaire are compared with these criteria in Table II. The results are shown in quartiles to reduce the effect of the extreme answers. Fifty per cent of the replies gave values between Q1 (25th percentile) and Q3 (75th percentile) while Q2 is the median value. Wide variations between the few extreme answers were a bit startling but the general agreement was very good.

The application of these four criteria to the correct-referrals and the relative size of the number failing each of the criteria each year is shown in Figure I. Refractive error is shown to be the most frequently failed item. Most of those failing visual acuity also failed according to other criteria, showing that visual acuity is the least independent of the

TABLE I.
Clinical Criteria for Referral

| | "Correct-Referral" |
|---|---|
| A. Visual Acuity | 20/40 or less, either eye |
| B. Refractive Error | |
| 1. Hyperopia | +1.50 D.S. or more |
| 2. Myopia | —0.50 D.S. or more |
| 3. Astigmatism | ± 1.00 D.C. or more |
| 4. Anisometropia | ± 1.00 D. or more |
| C. Coordination Problems | |
| 1. At Distance (20 feet) | |
| a. Tropia | Any Tropia |
| b. Esophoria | 5Δ or more |
| c. Exophoria | 5Δ or more |
| d. Hyperphoria | 2Δ or more |
| 2. At Near (16 inches) | |
| a. Tropia | Any Tropia |
| b. Esophoria | 6Δ or more |
| c. Exophoria | 10Δ or more |
| d. Hyperphoria | 2Δ or more |
| D. Organic Problems | Any verified pathology or medical anomaly of eye and/or adnexa |

criteria. Coordination and organic problems are the most independent.

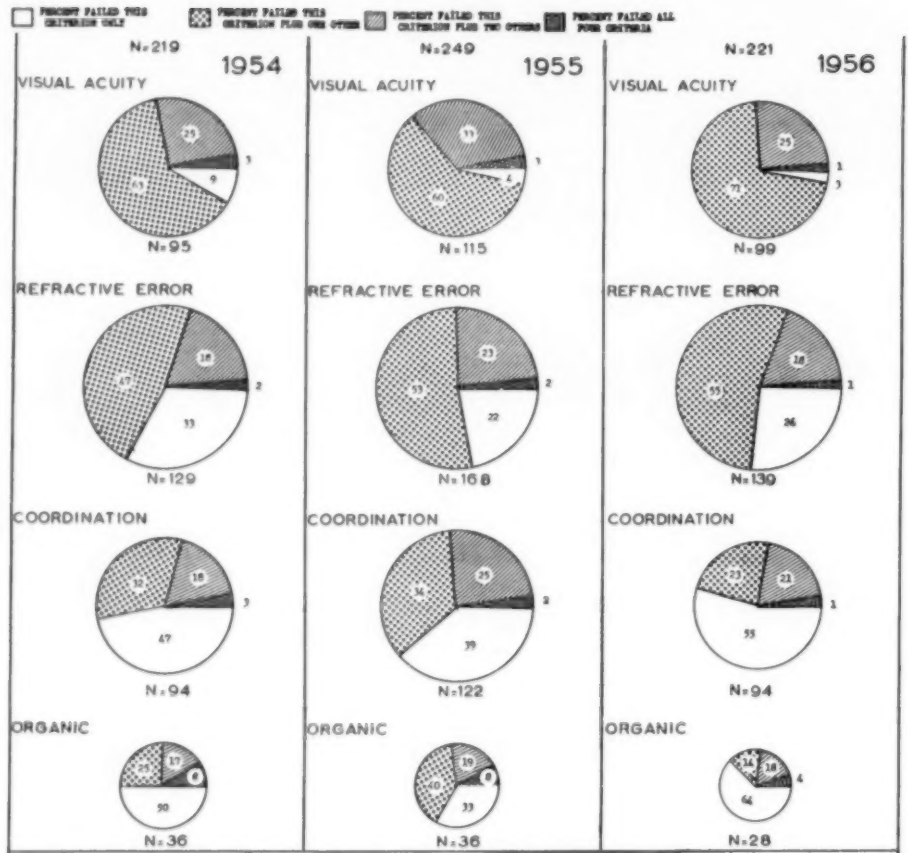
The evaluation of the efficiency of the various screening techniques was then made on the basis of clinical evaluations of each child.

EFFECTIVENESS OF VISION SCREENING METHODS

Although the technique is the item being tested, the examiner can easily alter the significance of the test, and every attempt was made to work under acceptable conditions with competent, adequately trained personnel as recommended for the technique. Results are shown for the three years of testing in Table III. The phi-coefficients show the relative

TABLE II
Clinical Criteria Compared to Interprofessional Screening Questionnaire

| | Clinical Criteria | Questionnaire by Quartile | | |
|---|---|---|---|---|
| | | Q 1 | Q 2 | Q 3 |
| A. Visual Acuity | 20/40 | 20/30 | 20/30 | 20/40 |
| B. Refractive Error | | | | |
| 1. Hyperopia | +1.50 D. | +1.00 | +1.50 | +2.00 |
| 2. Myopia | —0.50 D. | —0.50 | —0.50 | —0.75 |
| 3. Astigmatism | ±1.00 D. | ±0.50 | ±0.75 | ±1.00 |
| 4. Anisometropia | ±1.00 D. | ±0.75 | ±1.00 | ±1.50 |
| C. Coordination Problems | | | | |
| 1. At Distance | | | | |
| a. Tropia | Any | Any | Any | Any |
| b. Esophoria | 5Δ | 3Δ | 4Δ | 6Δ |
| c. Exophoria | 5Δ | 3Δ | 5Δ | 8Δ |
| d. Hyperphoria | 2Δ | 1Δ | 1Δ | 2Δ |
| 2. At Near | | | | |
| a. Tropia | Any | Any | Any | Any |
| b. Esophoria | 6Δ | 2Δ | 4Δ | 7Δ |
| c. Exophoria | 10Δ | 8Δ | 10Δ | 12Δ |
| d. Hyperphoria | 2Δ | 1Δ | 1Δ | 2Δ |
| D. Organic Problems | Any | Any | Any | Any |




COMBINATIONS OF CLINICAL CRITERIA FAILED - CORRECT REFERRALS

| Age Group | 1954 Total | 5 - 7 | 8 - 10 | 11 - 13 | 1955 Total | 6 - 8 | 9 - 11 | 12 - 14 | 1956 Total | 7 - 9 | 10 - 12 | 13 - 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 219 | 55 | 91 | 73 | 249 | 94 | 87 | 68 | 221 | 72 | 83 | 66 |
| Failed One Criterion Only | 116 | 25 | 49 | 42 | 100 | 44 | 33 | 23 | 109 | 44 | 42 | 23 |
| Visual Acuity | 9 | 4 | 3 | 2 | 5 | 3 | 1 | 1 | 7 | 2 | 5 | - |
| Refractive Error | 63 | 7 | 14 | 22 | 77 | 15 | 20 | 22 | 57 | 25 | 20 | 12 |
| Coordination | 44 | 12 | 20 | 13 | 47 | 23 | 14 | 10 | 31 | 23 | 21 | 9 |
| Organic | 18 | 3 | 13 | 2 | 13 | 3 | 6 | 4 | 18 | 9 | 9 | 2 |
| Failed Two Criteria | 78 | 23 | 33 | 22 | 108 | 38 | 40 | 30 | 86 | 23 | 35 | 28 |
| Visual Acuity and Refractive Error | 45 | 14 | 19 | 12 | 60 | 18 | 25 | 17 | 44 | 11 | 22 | 11 |
| Refractive Error and Coordination | 11 | 4 | 4 | 3 | 25 | 13 | 6 | 6 | 13 | 5 | 3 | 5 |
| Visual Acuity and Coordination | 10 | 2 | 7 | 1 | 8 | 1 | 5 | 2 | 7 | 2 | 4 | 1 |
| Coordination and Organic | 6 | 3 | 3 | - | 9 | 5 | 1 | 3 | 3 | 1 | 1 | - |
| Refractive Error and Organic | 2 | - | - | 2 | 5 | 1 | 2 | 2 | 3 | - | - | 3 |
| Visual Acuity and Organic | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - |
| Failed Three Criteria | 24 | 6 | 9 | 9 | 38 | 11 | 13 | 14 | 23 | 6 | 6 | 11 |
| Visual Acuity, Refractive Error, Coord. | 12 | 2 | 5 | 5 | 31 | 8 | 12 | 9 | 20 | 5 | 4 | 11 |
| Visual Acuity, Refractive Error, Organic | 6 | 2 | 2 | 2 | 7 | 3 | 1 | 3 | 3 | 1 | 2 | - |
| Visual Acuity, Coordination, Organic | 0 | - | - | - | 0 | - | - | - | 0 | - | - | - |
| Refractive Error, Coordination, Organic | 6 | - | - | - | 0 | - | - | - | 0 | - | - | - |
| Failed Four Criteria | 1 | - | - | 1 | 3 | 1 | 1 | 1 | 1 | - | - | 1 |
| Vis.Acuity, Refract.Error, Coord., Organic | 3 | - | - | 3 | 3 | 1 | 1 | 1 | 1 | - | - | 1 |

Fig. 1. Clinical criteria failed. Correct referrals.

merits of the procedures.

The most effective procedure, by a considerable margin, is the Modified Clinical Technique. It employs a few tests that cover a wide range of problems and has flexibility so that standards may be varied or tests changed to satisfy any set of local and professional demands. The Massachusetts Vision Kit makes relatively few over-referrals when failure on retest is required for referral (1956), but misses approximately half of those needing referral. The Telebinocular also finds approximately half, but over-refers many even when failure on retest is required for referral (1956). The California State Recommended Procedure misses approximately three-fourths of the correct-referrals, but if the cover test is eliminated (1955 and 1956), keeps the over-referral rate very low. The various forms of observation and questionnaires seem to be of little value in our hands.

COSTS OF SCREENING

In the calculations shown, currently paid hourly wages were utilized. Teachers and school nurses who are on a monthly, fixed salary were considered to have a cost factor equal to their hourly wage for the hours spent. Overhead costs were ignored. Volunteer's time was significant but was considered as cost free. Table IV shows the breakdown, by test, for each of the three years. In 1956, costs were 37 cents per pupil for The Massachusetts Vision Kit, 43 cents for the Telebinocular, 45 cents for the Modified Clinical Technique (MCT). Even with no training time involved in 1956, carrying out the California State Recommended Procedure was the most expensive at 53 cents per pupil.

Correct referrals must be regarded as a necessary community cost. However, over-referrals represents an unnecessary community cost. In Table V an estimate is made of what each screening procedure would cost the families in the community as a result of over-referrals. The failure to detect significant defects, the under-referrals, are also shown on this table. Since the MCT found nearly all of the cases needing referral, or twice as many as the next best test, it was concluded that of the useful tests MCT was much the least expensive to the community. Intially, MCT cost the school slightly less than some and slightly more than other procedures. MCT was therefore judged to be the most efficient and economical screening procedure tested by far.

VISION STATUS AND PREVIOUS CARE

The proportion of children with vision problems increased approximately 1.6 per cent per year with age over the period of time studied. In the age grouping 5-6-7, approximately 18 per cent had a problem

TABLE III. SCREENING EFFECTIVENESS

| Method | Correct-referrals | Under-referrals | Over-referrals | Non-referrals | Phi coefficient |
|---|---|---|---|---|---|
| 1954 N = 1163 | | | | | |
| Clinical criteria | 231 | 0 | 0 | 932 | (+1.00) |
| Parent questionnaire | 88 | 143 | 215 | 717 | +0.14 |
| Teacher observation | 75 | 156 | 203 | 729 | +0.10 |
| Nurse observation | 24 | 207 | 35 | 897 | +0.12 |
| State recommended procedure | 95 | 136 | 79 | 853 | +0.37 |
| Massachusetts vision kit | 157 | 74 | 358 | 574 | +0.24 |
| Modified clinical technique | 209 | 22 | 37 | 895 | +0.85 |
| 1955 N = 1475 | | | | | |
| Clinical criteria | 249 | 0 | 0 | 1226 | (+1.00) |
| Teacher observation | 89 | 160 | 90 | 1136 | +0.33 |
| Nurse observation | 54 | 195 | 16 | 1210 | +0.36 |
| State recommended procedure | 67 | 182 | 21 | 1205 | +0.40 |
| Telebinocular | 230 | 19 | 833 | 393 | +0.20 |
| Modified clinical technique | 244 | 5 | 27 | 1199 | +0.93 |
| 1956 N = 1274* | | | | | |
| Clinical criteria | 221 | 0 | 0 | 1053 | (+1.00) |
| Teacher observation | 106 | 115 | 218 | 835 | +0.24 |
| Nurse observation | 47 | 174 | 4 | 1049 | +0.40 |
| Parent questionnaire | 82 | 139 | 197 | 856 | +0.17 |
| State recommended procedure | 54 | 166 | 10 | 1039 | +0.41 |
| Massachusetts vision kit | 111 | 91 | 33 | 943 | +0.59 |
| Telebinocular | 113 | 89 | 67 | 910 | +0.51 |
| Modified clinical technique | 215 | 4 | 14 | 1018 | +0.95 |

*Not all tests could be completed for all children so total number varies with screening technique.

by our criteria (see Figure 2). This increased to 31 per cent of the children in the age grouping 13-14-15. The Orinda finding that the proportion of children who had some previous professional care increased with age will probably be repeated in most communities. It was found that more than half of those who had received professional attention previously could still not meet the study standards at the time they were screened in school (see Figures 3-A and 3-B). The majority of such children could be brought to these standards with further care. Only one-seventh of the children with referable vision problems (about three per cent of the total group) were considered to have defects uncorrectable to the study standards.

TABLE V.
PROJECTED COMMUNITY COSTS OF OVER-REFERRALS—1956
Assuming $15.00 per Professional Examination

| | Over-Referrals | | | | | Under-Referrals | |
|---|---|---|---|---|---|---|---|
| | Number | @ | | | Cost | Number | % |
| Teacher Observation | 218 | @ | $15.00 | = | $3,270.00 | 115 | 52 |
| Nurse Observation | 4 | @ | 15.00 | = | 60.00 | 174 | 79 |
| State Recommended Procedure | 10 | @ | 15.00 | = | 150.00 | 166 | 75 |
| Massachusetts Vision Kit | 33 | @ | 15.00 | = | 495.00 | 91 | 45 |
| Telebinocular | 67 | @ | 15.00 | = | 1,005.00 | 89 | 44 |
| Modified Clinical Technique | 14 | @ | 15.00 | = | 210.00 | 4 | 2 |

TABLE IV.

Analysis of Costs of Screening

| Method[a] | 1954 | | | | 1955 | | | | 1956 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hrs. | Total Cost | Time Child | Cost Child | Hrs. | Total Cost | Time Child | Cost Child | Hrs. | Total Cost | Time Child | Cost Child |
| California State Recommended Procedure | | | | | | | | | | | | |
| Teacher preparation[b] | 306 | | | | 95 | | | | — | | | |
| Teacher testing | 118 | | | | 81 | | | | — | | | |
| Nurse preparation | 197 | | | | 18 | | | | 15 | | | |
| Nurse testing | 51 | | | | 51 | | | | 184 | | | |
| Total | 672 | $2.352.[c] | 33 min | $1.93 | 245 | $857.50[c] | 9.8 min | $0.57 | 199 | $696.50[c] | 9.2 min | $0.53 |
| Telebinocular | | | | | | | | | | | | |
| Tester preparation | | | | | 5 | | | | 14 | | | |
| Volunteer training | | | | | 3 | | | | 3 | | | |
| Testing | | | | | 211 | | | | 142 | | | |
| Total | | | | | 219 | 766.50[c] | 8.8 | 0.51 | 159 | 556.50[c] | 7.3 | 0.43 |
| Massachusetts Vision Kit | | | | | | | | | | | | |
| Tester preparation | 4 | | | | | | | | 4 | | | |
| Volunteer training | 3 | | | | | | | | 3 | | | |
| Testing | 108 | | | | | | | | 133 | | | |
| Total | 115 | 402.50[c] | 5.7 | 0.33 | | | | | 140 | 490.00[c] | 6.4 | 0.37 |
| Modified Clinical Technique | | | | | | | | | | | | |
| Volunteer training | 2 | | | | 2 | | | | 2 | | | |
| Testing | 113 | | | | 125 | | | | 94 | | | |
| Total | 115 | 690.00[d] | 5.6 | 0.56 | 127 | 762.00[d] | 5.1 | 0.51 | 96 | 576.00[d] | 4.5 | 0.45 |

Note: Because the testing was not completed on all children the number tested varies with the method.

[a] Time and cost not calculated for Teacher Observation and Nurse Observation.

[b] Including prescribed six-hour training program.

[c] Based on hourly rate of pay for tester of $3.50.

[d] Based on hourly rate of pay for tester of $6.00.

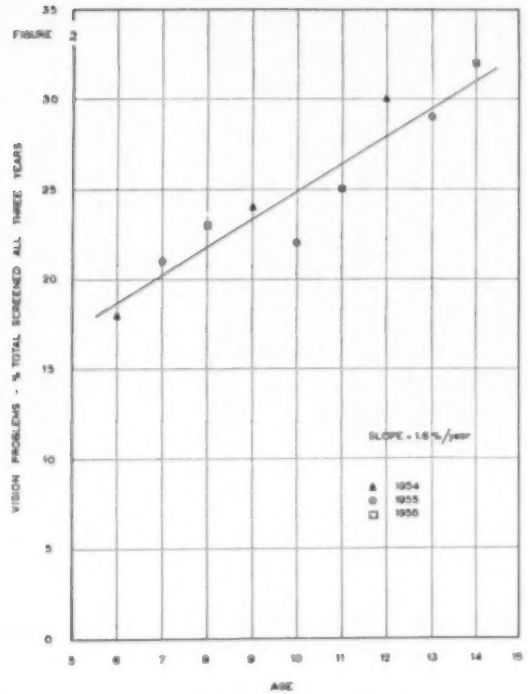



Fig. 2. Changes in incidence of vision problems with age.

CHANGES WITH TIME—A LONGITUDINAL STUDY

Changes in the two-year interval, 1954-56 (three years of testing), occurred more frequently among those with vision problems initially than among those who had no such problems. Increasing age was associated with an increase in the mean of the measures of refractive error, but only reached statistical significance at the five per cent level in the shift toward myopia. Large shifts toward more myopia, by those already myopic, and a shift of some normals to myopia were the major changes. Those with referable hyperopia tended to show more hyperopia. This was a minor, but not too infrequent tendency that is generally supposed not to exist.

Another point of great interest was that in the two-year elapsed time of our study the total number of correct-referrals declined from 20% to 17% of the total group. This decrease represents the combination of all factors acting in this situation, such as the change of some

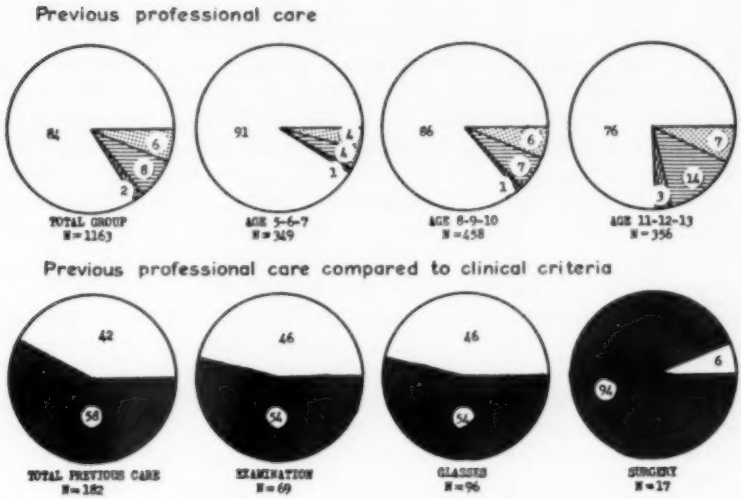



Fig. 3-A. Previous professional care. All children tested in 1954.

non-referrals to the new-referral category, the change of some ex-referrals to the re-referral category, and the persistence of a substantial number of re-referrals and new-referrals in these categories. Altogether the

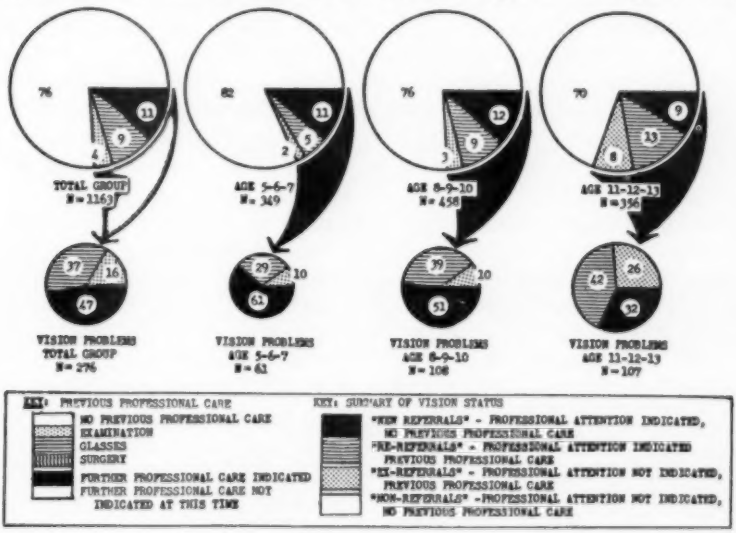



Fig. 3-B. Summary of vision status. All children tested in 1954.

program achieved a net correction of about 6.2 per cent in two years in a relatively well-to-do community. In spite of remarkable parent cooperation for the study much seemed to be needed in the way of parent education and enthusiasm to obtain the professional care which screening revealed as necessary.

From the study of the changes in referral category and the control group it is concluded that those children with vision problems change more and require frequent vision attention. After an initial screening by the Modified Clinical Technique, new referrals found in subsequent years could be identified by Snellen acuity testing.

## RECOMMENDATIONS

A successful vision screening program is greatly needed in elementary schools and can be set up in the following manner:

a. A steering committee with representatives from education, ophthalmology, optometry, public health, parents groups should develop the program. The committee, through its professional members, must obtain acceptance of the program and screening criteria by the professional persons in the community.

b. A qualified professional examiner should be utilized to provide the MCT, as described in Appendix I, for all children at the first grade and for all new entrants to the elementary school.

c. The examiner doing MCT should have a certificate of completion from an accredited school of optometry, or an M.D. degree with one year of specialized training in ophthalmology in an accredited training center, or two years of practical work in ophthalmology.

d. The professional MCT examiner should act as an employee of the agency responsible for the school health program and, even if part time, should not be in private practice anywhere in the region so that the economic interest of the examiner cannot become an issue.

e. Children who have had the MCT once, and who passed, should be tested annually thereafter with the Snellen test. Teacher observation should be done continuously. The Snellen testing and the reports of teacher observation, where feasible, should be completed prior to the annual visit of the MCT professional examiner. In this way, children failing the Snellen or referred by teacher observation could be screened by the MCT at the same time as the first graders are being examined, and before being referred for private professional attention.

f. The Snellen procedure, described in Appendix I, should be carried out by a qualified individual hired by the school to do the work once each year. This would avoid significant costs for teacher train-

ing as well as teacher screening.

g. Those children failing the MCT should be referred for professional vision attention. Criteria are given in Table I.

h. The parents of those children with known visual problems in grades two and above should receive a reminder of the need for regular professional attention once each year. They need not be screened.

i. The school health education program should include instructional units on visual health. It should also impinge on the parents so that there will be family interest in getting regular professional attention for children with vision problems.

j. The school administrator should receive from the professional examiner an analysis of the cases referred. This will provide an administrative control when compared to the results of this study.

k. The multi-professional steering committee should have the obligation of verifying the adequacy of the screening program, the absence of excessive under and over-referrals, and should modify the referral criteria to meet local professional practices. They should also participate in developing the school visual health education program without which much of the screening will not result in professional care for the children who are found to be needing it.

## SUMMARY

1. A three-year longitudinal study of the vision status of approximately 1,000 elementary school children was completed.

2. Many different screening procedures were compared with one another and against clinical examinations and clinical criteria which were established from the study results and which compared favorably with professional opinions as obtained on a nation-wide questionnaire.

3. The MCT, described in the appendix of this study, was remarkably efficient, economical and had the fewest over or under-referrals.

4. Recommendations are given for conducting satisfactory elementary school vision screening.

5. Detailed review of the subject, bibliography, data, analysis, discussion and criteria are available in a book being published by the University of California Press entitled "Vision Screening for Elementary Schools: The Orinda Study" by Blum, Peters and Bettman.

6. The role of a Health Department in promoting research in a disputed field involving many disciplines and interests is discussed.

## ACKNOWLEDGMENTS

Many persons contributed time and effort to plan and carry out this study. We wish to acknowledge the splendid cooperation of the Orinda parents and school personnel, without whose efforts the project could not have been accomplished. This

study was supported in part by the California State Department of Public Health and the Children's Bureau of the United States Department of Health, Education and Welfare. Technical assistance was provided by American Optical Company and Keystone View Company.

Other participants who deserve particular mention are:
Education: Margaret Bengston, P.H.N., Harold Kaar, Ed.D., Phillip Lambert, Ph.D., Joseph L. Sheaff, M.A., B. O. Wilson, M.A.
Ophthalmology: Edward Maumenee, M.D.
Optometry: George Bradley, O.D., Bernice C. Flom, O.D., George Hurd, O.D.
Public Health: Leslie Corsa, Jr., M.D., M.P.H., Frederick M. Kriete, M.D., M.P.H., Nedra B. Belloc, M.A., Theodore Montgomery, M.D., M.P.H., Clare S. Winder, P.H.N., Phyllis Hecker, M.P.H.
Parents Group: Mrs. Robert Creighton, Mrs. F. R. Hildebrand, Mrs. Huntley, Mrs. Coleman, Mrs. William Kooreman, Mrs. E. Starkman, Mrs. David Thaxter.

## APPENDIX I.

*The Modified Clinical Technique* consists of the following tests:

1. Visual acuity. Using a table model projector type instrument (e.g. American Optical Company Projectochart Model 1217) with appropriate slides for both letters and illiterate E charts projected on a screen at twenty feet, measure visual acuity of each eye.

2. Cover test. Using the above projector showing a critical letter on the screen and an occluder, perform both the cover-uncover and alternate-cover tests for a distance of twenty feet. A loose prism of 5$\Delta$ may be used for accurate determination of coordination at the cut-off point. With a critical letter target held at 16 inches and using 6$\Delta$ and 10$\Delta$ loose prisms determine by the cover test the coordination at the near point.

3. Skiametry. The equipment required includes a small movie projector and screen, a retinoscope, 2 pairs of +1.50 D.S. lenses in trial frames, and a test lens bar. The child being tested observes a cartoon film projected on a screen at a distance of twenty feet through a pair of +1.50 D.S. lenses. Since it is desirable to have the child look through the lenses for at least one minute before the test is made, the lenses can be placed before the child's eyes and he can observe the film while the examiner performs tests #1 and #2 on the next child. When performing the retinoscopy test the lens bar containing lenses of —0.75, +0.75, +1.50, +2.25 diopter spheres is held in front of the trial frame lenses. The best estimates of the total refractive error for the vertical and horizontal meridians are recorded separately. Only where there is a marked oblique astigmatism are other meridians reported.

4. Inspection for organic problems. With a hand magnifier and ophthalmoscope check for external and internal organic problems as needed.

Note that the Modified Clinical Technique is a flexible procedure and other tests may be included. For example, color tests may be added if desired. The above tests are considered to be a minimum to find essentially all those with vision problems needing professional attention. It provides for an objective test of refractive error to be compared to the subjective visual acuity, an objective test of coordination and of organic problems.

*The Snellen Test*

The Snellen test for visual acuity should be given annually to all children except those scheduled for the Modified Clinical Technique and those with known vision problems. The recommended procedure and equipment is:

1. A visual acuity chart of black characters on a white background with self contained illumination (e.g., Good-lite Eye Chart Model A) with both letter characters and illiterate E charts at 20 feet.

2. Test visual acuity of each eye separately and record as the Snellen notations for the line of the smallest figures identified correctly with no more than two figures missed per line. A hand-held occluder of white, opaque, washable plastic should be placed before the eye that is not being tested and both eyes should be open at all times. The child should not be allowed to "squint" or "narrow eye lids" to see the chart.

3. Those failing the visual acuity screening should be sent for retest by the Modified Clinical Technique.

*Teacher Observation*

Teacher observation for visual problems should be done continuously. Those suspected of having problems associated with vision should be sent for vision screening by the Modified Clinical Technique, or if after the annual MCT testing, to the nurse. There are four areas of observation that deserve particular attention:

1. Evidence of ocular abnormalities—crusted, red-rimmed, swollen lids, frequent styes, watering or bloodshot eyes, crossing of eyes.

2. Complaints of visual distress—sensitivity to light, burning or itching of eyes or lids, blurring or seeing double, words and lines running together, words jumping, headache.

3. Performance which suggests eye difficulties—rubbing eyes frequently, blinking frequently when reading, facial distortion when reading, closing or covering one eye or tilting head to one side when reading, or watching classroom movies, abnormal posture when doing close work, holding work too close or too far, irritable, short attention span, tenseness in reading.

4. Evidence of difficulty or dislike or inattention for reading, reading subjects, fine work.

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## ANNOUNCEMENT

### FALL SEMINAR—LOS ANGELES COLLEGE ALUMNI ASSOCIATION

The Los Angeles College of Optometry Alumni Association announces its Fall Seminar will be held on Saturday afternoon, October 17, at the College, 950 West Jefferson Blvd. The Seminar will feature leading optometric and medical speakers who will review recent developments in the fields of contact lens fitting, pathology and practice management. All alumni are invited to be present.

# THE PRINCIPLES OF TONOMETRY AND THE SCHIOTZ TONOMETER*

## PART I

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### INTRODUCTION

The present paper is the first of a series designed to acquaint the reader with the theoretical considerations relating to tonometry, the available instrumentation, and the status of scleral tonometry in the light of recent investigation.

That glaucoma is a disease frequently associated with an elevation of intra-ocular tension was first appreciated by Von Graefe in 1860. Although manometric means are available for precise measurement of the internal pressure of the eye, such methods cannot be used in clinical application. Hence, indirect methods of pressure estimation have evolved despite their limitations.

To date, the clinically practical tonometric devices fall into two categories, aplanation and impression.

When the foot of an aplanation instrument is allowed to rest upon the cornea and to exert a force of known magnitude thereupon, the corneal surface is caused to conform in curvature to the instrument foot over an area which is a function of the intra-ocular pressure. Fick and Maklakow have formulated the equation $W = P \times A$, W representing the weight of the tonometric instrument in grams, P representing the intra-ocular pressure expressed in grams per square centimeter, and A representing the area of corneal aplanation in square centimeters.

All of the early aplanation tonometers were associated with a large reading error. Lloyd[1] has described these primitive instruments in detail. Although recent aplanation instruments have been developed in which the reading error is virtually eliminated and although these instruments are, in some respects, more satisfactory than the impression variety, they have found but limited use and for that reason will not be included in the present paper.

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*Read before the annual meeting of the American Academy of Optometry, Boston, Massachusetts, December 14, 1958. For publication in the September, 1959, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

Part II will appear in the October, 1959, issue and Part III in the November, 1959, issue.

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IMPRESSION TONOMETERS

The impression or indentation tonometer in it's most primitive form consisted simply of a rod which of it's own weight was allowed to press into the cornea. An estimate of the depth of corneal indentation was then made and from it was inferred the hardness of the eyeball. Early impression type instruments suffered from the disadvantage that exact estimates of depth of indentation were not possible.

Precise readings as to depth of corneal indentation became possible only after Schiotz perfected his familiar device. In it, a plunger loaded with a known weight is allowed to operate through a concave footplate of lesser curvature than the cornea. In the conventional Schiotz instrument the end of the plunger bears the same curvature as does the footplate. The footplate is centered upon the cornea and a lever mechanism magnifies the plunger motion by a factor of twenty as the plunger indents the cornea. A needle attached to the lever mechanism registers upon a scale affixed to the superior aspect of the instrument and depth differences of less than 0.05 mm. may thereby be determined.

The tonometers of McLean, Gradle, Harrington, Bailliart, and Wolfe are merely mechanical variants of the Schiotz while the electronic tonometer, such as that of Mueller, replaces the mechanical lever system of the Schiotz by an electronic system which allows readings of great precision.

THE SCHIOTZ TONOMETER

Figure 1 demonstrates the Schiotz tonometer with two auxiliary weights. Certain important variables in this instrument were specified by Schiotz whereas other equally important variables were not. As long as tonometers were manufactured under his direct supervision and as long as he inspected each completed instrument, no great variations from the original design occurred. However, as various manufacturing firms began to reproduce this instrument, deviations from the original began to appear. Because of lack of standardization the limits of normal pressure varied from one instrument to another. A report of the tension readings for a given patient was necessarily accompanied by a notation as to the "normal" and the "upper limit" values for the instrument employed.

The earliest efforts toward tonometer standardization embraced a comparison between clinical readings obtained on living human eyes when findings of the instrument in question were plotted against those of a reference standard tonometer. A corrected scale was constructed for the instrument under test and the clinical use of this scale yielded values comparable to those which would have been obtained had the reference

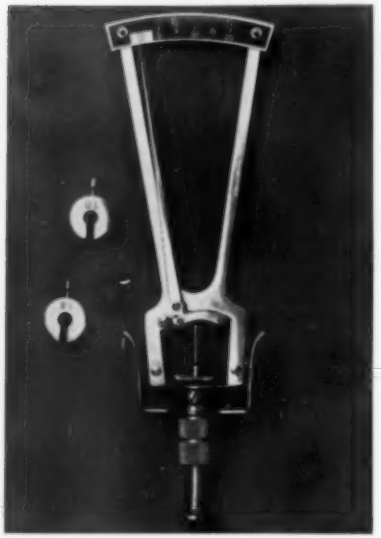

Fig. 1. A Schiotz tonometer together with two accessory weights, 7.5 and 10 grams. Fifteen-gram accessory weights are sometimes used with the Schiotz instrument, particularly when exceptionally high pressures are to be measured.

standard instrument been employed. This method suffers from two rather serious disadvantages. First, because of the massage effect [2a] only eyes with a markedly reduced rate of outflow can be employed. Second, readings on a minimum of twenty eyes [2b] are requisite if the "fault" in an aberrent instrument is to be adequately corrected. Obviously, a sufficient number of eyes with "fixed" tension is not available for the calibration of the many tonometers manufactured each year.

Arnold and Karpow[2c] in Turbingen constructed a tambour manometer which they used as an alternative to living human eyes in standardization of tonometric devices. The drum was brought to desired tension and the tonometer reading on the drum by the instrument under test was compared with that of a reference standard tonometer. Correction of the "fault" by this method did not yield an instrument which was entirely comparable to the reference standard when applied to the living human eye.

The first practical solution to the problem of tonometer standardization was initially suggested by Schoenberg and Posner and later refined by Kronfeld. This solution consisted of the precise measurement of all significant physical variables. Kronfeld obtained tonome-

ters which deviated from specifications as to single variables.[2d] He then plotted readings taken on human eyes with fixed tension by the deviant instruments against like readings obtained with the use of a reference standard instrument. Curves were plotted from which the effect of single deviations upon the clinical reading could be computed and effects of combined deviations could be inferred. This method of standardization—the measurement of all of the essential physicial characteristics of a tonometric device—is used in America today to the exclusion of all other methods.

Table I is a listing of the March, 1952, specifications for Schiotz tonometers as recommended by the American Academy of Ophthalmology and Otolaryngology Committee on Tonometer Standardization.

CALIBRATION OF THE SCHIOTZ TONOMETER

Schiotz initially made no recommendation that his instrument be used to yield mercurial pressure values.[3] Rather, he suggested that a given tonometric reading be expressed as a fraction, the numerator representing the tonometer scale reading and the denominator the weight of the plunger load in grams. The tonometric finding when utilized in this manner was of great utility in recognition of glaucoma and was especially valuable in that such notation was representative of objective fact. It gave the user no illusion that the tonometric instrument provided a measure of internal pressure of the eye in any scientific sense.

Although conversion of the Schiotz reading into millimeters of mercury as is practiced today is attended by the advantage that the relationship between the 5.5, 7.5, 10 and 15 gram weights is readily apparent, it is most unfortunate that it has resulted in the creation of the erroneous impression in the minds of many users that the value thereby determined is an accurate expression of objective pressure within the eye. In reality, several factors other than intra-ocular pressure influence tonometric reading in such a manner that the latter provides only a crude index to actual pressure within the eye.

The earliest attempt at determination of the mercurial pressure equivalents of the Schiotz scale readings was undertaken by Schiotz himself who obtained eight human eyes at autopsy, covered the cornea of each with a thin layer of latex to prevent dessication, and connected them one by one with a hydraulic system consisting of a saline filled manometer and reservoir.[2e] A cannula was inserted into the vitreous chamber by way of the stalk of the optic nerve and the eyeball was supported by a clamp attached to the cannula. By aspirating a small amount of vitreous, free communication was established between the intra-ocular contents and the balance of the fluid system. The reservoir could be

TABLE I.

Specifications for Schiotz tonometers (March, 1952)

All tonometers and plungers are to carry serial numbers. The manufacturer of the tonometer is to be designated on the tonometer.

| Test | Standard | Limits |
|---|---|---|
| Weight | | |
| Plunger, lever and pointer | | |
| Scale indication 5 | 5.5 gm. | ±0.15 gm. |
| Scale indication 10 | 5.5 gm. | ±0.25 gm. |
| Tonometer without handle | 16.5 gm. | ±0.5 gm. |
| Load 7.5* | 2.0 gm. | ±0.02 gm. |
| Load 10 | 4.5 gm. | ±0.02 gm. |
| Load 15 | 9.5 gm. | ±0.02 gm. |

*The load marked 7.5 weighs 2 grams. This load, together with the 5.5 grams of the plunger assembly, lever and pointer totals 7.5 grams.

Friction between plunger and sleeve, Negligible. The test for friction between the plunger and the sleeve shall be that the plunger slides freely in the barrel when its axis is no more than twenty-five degrees from the horizontal. This test is to be made with the tonometer face up, face down, and in the two lateral positions.

Friction between handle and sleeve, Negligible.

| | | |
|---|---|---|
| Footplate | | |
| Diameter | 10.1 mm. | ±0.2 mm. |
| Curvature | 15.0 mm. | ±0.25 mm. |

Diameter of curved surface, 9 mm. Tonometer footplate shall be free from visible dents, tool marks, and scratches, and should have a highly polished surface. The criterion regarding the polish will be whether or not footplate curvature can be satisfactorily measured by an optical method.

| | | |
|---|---|---|
| Plunger | | |
| Diameter (measured 0° - 90°) | 3 mm. | ±0.03 mm. |
| Curvature | 15.0 mm. | ±0.75 mm. |

Edge curvature smooth, radius, 0.212 min. 0.300 max. The plunger foot shall be free from visible dents, tool marks, and scratches, and must be highly polished.

| | | |
|---|---|---|
| Scale indication | | |
| On 15 mm. standard | —1 | ±0.2 |
| On 16 mm. standard | 0 | ±0.2 |
| On own block | 0 | ±0.2 |
| Micrometer | | |
| Scale 5 | 5.0 | ±0.25 |
| Scale 10 | 10.0 | ±0.25 |
| Scale 18 | 18 | ±1.0 |
| Wobble | | |
| Plunger | 0 | 0.4 max. |
| Fulcrum | 0 | 0.4 max. |

Wobble is measured in terms of the tonometer scale units. The pin at the fulcrum shall fit into its hole without wobble. Measurement of this is to be determined by inspection and by smoothness and reproducibility of the pointer reading on the micrometer block as the plunger is raised and lowered.

| | |
|---|---|
| Extension of the plunger, below footplate, millimeters | 3.0 max. |
| Pointer, millimeters | |
| Depth | 3.0 max. |
| Thickness | 0.25 max. |
| Distance between scale and pointer | 1.0 max. |
| Plunger contact with hammer | Perpendicular 5-10 scale |
| Hammer | Underside smooth—free from pits |

The tonometer shall have generally good construction. Test block should have a

(Footnote continued on following page.)

raised or lowered thereby providing a mechanism by means of which an intra-ocular pressure of any desired value could be produced. When desired pressure had been established within the eyeball, a stopcock permitted the isolation of the eye from the balance of the system.

Figure 2 is a simplified schematic diagram demonstrating the principle of monometric tonometer calibration.

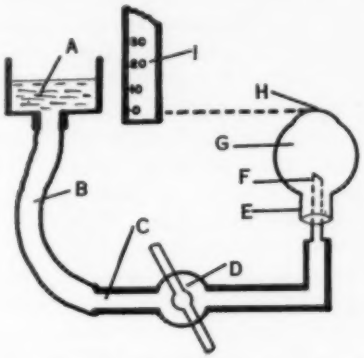


Fig. 2. A simplified schematic diagram demonstrating the principle of manometric tonometer calibration. A. Normal saline solution in reservoir. B. Flexible tubing. C. Glass tubing. D. Stopcock. E. Optic nerve. F. Cannula. G. Vitreous chamber. H. Corneal apex. I. Centimeter scale.

The value obtained when the tonometer was allowed to rest upon the cornea was plotted against the manometer reading obtained prior to closing the stopcock. This procedure was followed at each manometer setting for each eye. The resulting graph showed such wide scatter that curve fitting was considered to be a near impossibility.

Schiotz repeated the calibration procedure as before except that the stopcock was not closed during tonometer application. This time the tonometer scale readings were found to be considerably higher than before indicating a greater degree of indentation by the tonometer plunger. When tonometer scale readings were plotted against manometric readings in this instance, the scatter was considerably less than in the preceding case. A relatively simple curve was fitted to the data. By virtue of the fact that the open stopcock technique resembles only to a very limited extent the situation encountered in clinical tonometry,

polished surface. 16 mm. ±0.04 spherical curvature. ±0.04 mm. deviation from sphericity over an area of 11.0 millimeters minimum diameter. Tonometer case should be dust free and should contain a place for the plunger and 5.5 weight so that the tonometer can be disassembled for packaging. Schiotz calibration chart must be correct.

Schiotz attempted to translate his open stopcock curve so that it might be centered upon the closed stopcock data. He found, however, that he was unable to center the curve in it's entirety and hence was content to allow some deviation to occur at the extremes in compensation for a reasonably good fit between the scale readings of three and 10. The clinical conviction that Schiotz readings outside of the three to 10 limit are of no utility arises not from any fault inherent in the tonometric instrument but rather from the fact that the original Schiotz calibration curves are not applicable outside of this range.

OTHER FACTORS WHICH INFLUENCE TONOMETER READINGS

Obviously faulty technique may be responsible for inaccurate pressure readings in some cases. Shope[4] has cited the following possibilities: (1) Tonometer not applied to corneal center. (2) Tonometer not erect. (3) Fingers pressing upon the globe. (4) Lids touching cup-shaped base. (5) Patient squeezing eyelids. (6) Unsteadiness of ocular fixation. (7) Lack of correction for movements of eye when it is covered, the movements being due to heterophoria. (8) Pressing down or lifting up on handle while obtaining tonometric reading.

Factors other than procedural errors which influence the tonometer readings have been cited by Harrington and Parsons:[5] (1) Rigidity of ocular coats. (2) Volume of corneal indentation produced by tonometer plunger. (3) Distortion of cornea by tonometer footplate irrespective of indentation by plunger. (4) Expulsion of intra-ocular fluid by the weight of the tonometer. (5) Mechanical accuracy of tonometer as to: (a) Adherence to specifications. (b) Reduction of reading errors.

OCULAR RIGIDITY

When a tonometer is placed upon the eye, intra-ocular fluid is displaced not only by the plunger but also by the tonometer footplate. Resistance of the coats of the eyeball to stretch and of the vascular bed to compression has been termed ocular rigidity.[2f*] When ocular rigidity is low, displacement of a volume of fluid by the tonometer has little effect upon actual pressure within the eyeball. However, when the scleral tissues are highly resistent to stretch and/or the vascular bed of the eye is highly resistent to compression, indentation of the cornea by the tonometer tends to increase markedly the actual pressure within the eyeball during tonometry. Since it is the pressure in the eyeball prior

*Corneal resistance to deformation as an important factor in clinical tonometry has been dismissed by Friedenwald who found, in the course of his open stopcock studies, that the great variations in corneal thickness encountered when eyes of animals of different species were utilized produced negligible variations in tonometric reading.

to tonometer application with which we are concerned, Friedenwald has developed a method of correcting the estimate of the intra-ocular pressure for other-than-average coefficients of ocular rigidity. In clinical application, the coefficient of ocular rigidity and the "true" intra-ocular pressure which existed prior to tonometer application may be determined on the basis of tonometer scale readings recorded at each of two plunger loads. In order to eliminate the necessity of employing mathematical formulas in this determination, Friedenwald has established a pressure-rigidity monogram for use with the Schiotz tonometer.[2g] Harrington and Parsons[5] have published tables from which this same information can be obtained. This technique is less cumbersome than the use of the Friedenwald monogram.

The reason for the marked difference between open and closed stopcock data should now be apparent. Under open stopcock conditions, fluid displaced by the tonometer is readily expelled from the eye and the degree of rigidity of ocular coats is of no consequence. On the other hand, under closed stopcock conditions, fluid it not permitted to leave the eye and hence ocular rigidity influences the tonometric estimate of intra-ocular pressure in just the same way as it does in the clinical situation.

CRITICAL PRESSURE

It has been mentioned that the tonometer foot as well as plunger is effective in displacing fluid and hence is related to the effect of ocular rigidity upon the clinical reading. Application of a tonometer of fixed weight to the cornea causes corneal curvature to be altered so as to conform in radius to the tonometer footplate over an area which is a function of intra-ocular pressure.[2h] A certain pressure will exist at which the upward force of intra-ocular pressure per unit area will just balance the downward weight of the tonometer per unit area when total contact exists between the face of the footplate and the corneal surface. This pressure is known as critical pressure and its value for a given tonometer at a given plunger load is defined by the total weight of the instrument and the surface area of the contact face of the footplate.

Figure 3 illustrates a tonometer resting upon the cornea when pressure in the eye is above, at, and below the critical pressure of the tonometer.

When the intra-ocular pressure is at or above the critical pressure of the tonometric instrument, the volume of fluid displaced by tonometer footplate is minimal and varies in an even manner with alterations in the intra-ocular pressure. When the pressure in the eye drops below the critical pressure of the tonometric instrument, however, there is an

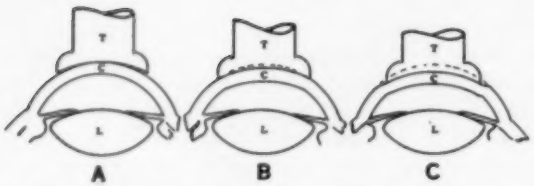


Fig. 3. The figure demonstrates the relationship which exists between the cornea and tonometer footplate when the eye is: A. Above the critical pressure of the instrument. B. At the critical pressure of the instrument. C. Below the critical pressure of the instrument. T represents the tonometer stem and foot. C represents the cornea. L represents the lens of the eye.

abrupt increase in the volume of fluid displaced by the footplate and ocular rigidity assumes a role of extreme importance. For this reason, tonometric readings are generally less reliable whenever an instrument is used to measure pressures at levels below its critical pressure.

Table II indicates the value of critical pressure of the Schiotz tonometer at various plunger loads.

TABLE II.

| Plunger load (grams) | Weight of footplate assembly plus plunger (grams) | Critical pressure (mms. Hg.) | Tonometer scale reading at critical pressure |
|---|---|---|---|
| 5.5 | 16.5 | 16.9 | 17.5 |
| 7.5 | 18.5 | 19.3 | over 20 |
| 10.0 | 21.0 | 21.8 | over 20 |
| 15 | 26.0 | 26.8 | over 20 |

## EFFECT OF CORNEAL RADIUS UPON THE TONOMETER READING

The volume of fluid displaced by a tonometer is related to the radius of curvature of the internal corneal surface. This is a consideration of no small import when attempts are made to calculate the "true" intra-ocular pressure in those cases in which deviation of corneal curvature from it's modal value is marked, for example, in hydropthalmos. Friedenwald[21, 2] has derived a correction formula for use in these exceptional cases and from this formula, tables have been established which are well suited to clinical use. Within normal limits of corneal curvature variation, however, corneal radius need not be taken into consideration when interpreting the tonometric reading.

## SUMMARY

A brief history and the basic forms of tonometers are presented. The Schiotz tonometer, it's initial calibration, and factors other than intra-ocular pressure which influence the clinical readings of this instrument are discussed. Mention has been made of the method of Frieden-

wald whereby the coefficient of ocular rigidity and the "true" pressure of an eye can be determined with the Schiotz scale readings obtained at each of two plunger loads.

ACKNOWLEDGMENTS

The writer wishes to express his appreciation to Dr. M. J. Allen of the Division of Optometry, Indiana University, Bloomington, Indiana, for his assistance in the preparation of this paper. He also wishes to thank Dr. H. W. Hofstetter, Director of the Division of Optometry of Indiana University, for his helpful criticism and suggestions.

JEFFERSON AND GOULD STREET

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## ANNOUNCEMENT

## SECOND MID-NORTHERN CONTACT LENS CONFERENCE AT ST. PAUL

The Contact Lens Association for Optometry announces that the second Mid-Northern Contact Lens Conference for Optometry will be held at the Hotel Lowry, St. Paul, Minnesota on November 1 and 2. The following optometrists will speak: Dr. Samuel E. Alperen; Dr. Edward W. Lenzen; Dr. Fred Sanger; Dr. Irving P. Filderman; Dr. John R. Kennedy and Dr. Roy Teshima. The meeting is open to all optometrists.

# "DYNAMIC MYOPIA"—A THEORY AND DISCUSSION OF THE EXPERIMENTAL CRITERIA FOR IT'S PROOF*

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## INTRODUCTION

The purpose of this presentation is to help resolve the current controversy over the genesis of myopia, i.e., the biologic versus environmental theories. The value lies in the possible potential reversibility of myopia. There is not at the present time an unequivocally understood basis for the mechanics of myopia, and the literature is glaringly devoid of studies using the experimental criteria necessary to resolve the problem.

The term "dynamic" is often used idly. In this paper the word is used in the strict sense as in mathematical applied mechanics. This is the value of plodding through the definition of the word itself.

## DEFINITION OF "DYNAMIC"

The word "dynamic," as used in applied mechanics in the field of engineering, means "a system responding to an impact of energy input," which definition is as yet foreign to the fields of ophthalmology and optometry, and yet this concept should be accepted in these fields so that correction of the disorder, myopia, may be logically attempted. The elaboration to follow is based on this understanding of the term.

Part of the energy input mentioned above acts directly on the system, and part is dissipated as it is absorbed by drag or resistance mechanisms. The system has a time lag in its response to energy input—known technically as "time response" or, simply, "lag," referring to the length of time required for the system to attain a new equilibrium state. Mathematically, lag is a function of (calculated from) the physical characteristics of the system, and is not a function of the energy input. Energy inputs or stress patterns may be applied in almost any conceivable form—for an instant, continuously, or intermittently, and in varying amounts. In specific, mathematical terms the dynamic system is the "transient solution" (picture) of a system under the impact of energy input. A dynamic system is reversible as the polarity of the energy input is reversed.

*Submitted on April 15, 1959, for publication in the September, 1959, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

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Contrast this with the static system, in which there is neither change in the energy input nor change in the characteristics of the stress pattern. The static system is in a state of steady and motionless equilibrium with its stress patterns and is therefore mathematically termed the "steady-state solution" of a system not undergoing the impact of energy inputs. It is apparent that a dynamic system becomes a static system as the motion or displacement of the system attains a steady and non-varying value.

An example involving both the dynamic and the static systems is the act of a person stepping into a car. His body weight is the energy input, a force in this case: the dynamic system response is the transient response of the car as it dips down and then slightly up. Some energy is dissipated in the friction of the springs and shock absorbers. When a steady displacement has been attained, due to the person's body weight, the system has become static. Very simply then, the dynamic system is the transient response of a system to a stress pattern, and the static system is the steady-state equilibrium.

The static system is non-varying in motion, and the stress pattern is constant: here, time has no meaning, for the system is the same now as it will be later. For the dynamic system, time is the very crux of the entire situation, i.e., how long the stress pattern lasts and how it varies throughout the system displacement, the amount of displacement as a function of time, and the value of the time response. A dynamic system is potentially static and a static system is potentially dynamic, for the only differentiation is whether the system is in the transient-state equilibrium or in the steady-state equilibrium. There are many instances where the dynamic transient solution is negligible or of little concern. These may be cases in which the transient solution occupies a relatively short or negligible time interval in comparison with the rather indefinitely long static time interval, or the magnitude of the dynamic displacement may be of no practical significance.

It must also be inquired whether a particular stress pattern elicits a response in a specific system. If the two are unrelated, and if the stress pattern will never elicit a response from the system, then it is obvious that the system is static in reference to that particular stress pattern.

## STATEMENT OF THE PROBLEM

Recognition of the logic of an environmental basis for myopia ("dynamic myopia") must be strengthened by experimental recognition of its existence. Previous studies using the criteria essential to reveal this phenomenon are paralyzingly few.

CRITERIA FOR EXPERIMENTAL DESIGN

In order to show whether or not a dynamic component exists, a study must have the features which will elicit such a response. If something is dynamic, it has the dimension of time. Heretofore most studies have been transverse (cross-sectional), basically eliminating the function of time and thereby classifying the transverse study under the category of static phenomena. The transverse study shows "comparison information" as to the incidence of myopia within the compared classes. Attempting to elicit a dynamic component with a transverse study is analogous to taking a photograph of an object in the air and attempting to determine the direction and speed of the object from that photograph. The drawing of conclusions from the results of a transverse study, as to whether or not near work stress patterns cause myopia, is *highly speculative*. (See Nadell, et al.,[4] for review of the important transverse studies and a few of the longitudinal studies.) In order to bring out a dynamic component, a study inherently employs the dimension time and thus becomes a longitudinal study. Such a study must also have controlled stress factors or information as to the degree of the particular stress factor in question. A study involving time and controlled stress factors and/or known degree of stress will allow the researcher to discover whether a dynamic component exists and, if so, the other characteristics pertaining to a dynamic system.

ABSTRACTS FROM KEPHART, HIRSCH AND BERENS

A study adhering to the above criteria was done by Kephart, et al.,[1] and repeated three times to verify the striking results obtained. The experimental design was longitudinal with academic near visual tasks of children during the school year versus the relative lack of their near visual tasks during the summer used as the controlled stress factor. Retinoscopic examinations were performed on each child, once in September and once in May. The study, as designed, meets the criteria for eliciting a dynamic component, and, in fact, a dynamic component of myopia was exhibited.

The difference found between testing indicates that a change in visual status does occur during the summer vacation period. An examination of the means reveals that the fall testing shows a lesser degree of myopia than the spring testing. . . . Thus, the earlier conclusion by Kephart, that a recovery from the myopia trend occurs during the vacation period, is upheld.

With a similar experimental design, Hirsch[3] reached conclusions in direct contrast to those of Kephart: the myopia trend evident during the school year was found not to reverse during the summer but rather

to continue at the same or a slightly increased rate[2] . . . the reason for the contradictory results is not clear.[4]

"Tachistoscopic Training" by Berens, et al.,[2] was designed to bring out a reversible, hence dynamic, component of myopia. The results were inconclusive. Berens' subjects ranged in age from six to forty-seven years with a mean of 22-23 and a standard deviation of ten, and there was no breakdown into age groups except for one selected group, ages 11 to 26, within which a significant increase in reading ability occurred.

If it is at all possible to draw conclusions from these studies only, they might be said to show the existence of a dynamic component and the greater prevalence of this component among the younger age groups.

THE OPPOSITION TO "DYNAMIC MYOPIA"

It is commonly thought that myopia is the result of a "too long eyeball" and that dynamic myopia therefore cannot exist. This viewpoint is fallacious for two excellent reasons. First, in Sorsby's[5] work, it is shown that, with few exceptions, values for axial length, corneal power, and lens power, of the order commonly seen in emmetropia, recur in the ametropias up to $\pm 4$ D. of ocular refraction. These eyes are ametropic, not because of any abnormal constituents, but because of faulty correlation of the individual components, and the degree of ametropia is the measure of the degree of faulty correlation.

Secondly, to infer that faulty growth is an unalterable pattern, excluding response to stress patterns, is teleologically unsound and unproven, especially in the face of accepted medical concepts of "disuse atrophy" and "use hypertrophy," both the direct consequences of a dynamic response.

Myopia in a young person is usually corrected by a minus lens. It has often been pointed out that the myopia progresses despite this minus lens correction, and this progression is considered to be evidence for the existence of biologic myopia or myopia of the unalterable growth pattern type. If myopia is biologic and unalterable, the fitting of minus lenses will certainly not alter the progression into myopia, but if myopia is a dynamic response mechanism, the fitting of minus lenses will directly induce a response in the direction of increasing myopia because the minus lens presents a stress pattern of the correct polarity to induce further progression. This known progression of the corrected myope is therefore in immediate agreement with the concept of dynamic myopia and not evidence against it.

DISCUSSION

There is not at the present time an unequivocally understood basis

for the mechanics of myopia, and the literature is glaringly devoid of studies using the experimental criteria necessary to resolve the controversy. The value of resolving this controversy lies in the potential reversibility of myopia.

I propose a study which would be longitudinal, with controlled stress patterns or known degree of stress patterns. The study would be made on a random population of young myopes, not previously fitted with lenses, and without detectable pathology or anisometropia of greater than one diopter. These myopes would be fitted with plus or minus lenses, randomly assigned, and the course of their myopia followed over a period of years. The technical classification of myopes could be made according to standard ophthalmological and optometric procedures usually employed in refractive work.

SUMMARY

The progression of myopia may be postulated as a dynamic response by a system to environmental stress patterns. This postulate requires a specific definition and concept of the term "dynamic" as it is used in the fields of applied mathematical mechanics. This dynamic system responds to the impact of energy input, part of the energy displacing the system and part being dissipated in drag and resistance mechanisms. This is contrasted with a static system at steady-state equilibrium. In the static system time has no meaning, but time is a basic part of the dynamic system. Using criteria defined on this postulate and definition of dynamic myopia, such criteria necessarily including longitudinal investigation and controlled or known degrees of stress patterns, a dynamic component of myopia can be found if it is present. Only the study of Kephart and Unger and the study of Berens, et al., have met these criteria, and the conclusions which can be drawn from these two studies are potentially promising but inconclusive at this time. In order for knowledge and understanding of the basis for myopia to be complete, much more actual experimentation, using the proper methods, must be done.

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1536 E. MINNEHAHA PARKWAY
MINNEAPOLIS, MINNESOTA

## ANNOUNCEMENT

### VISUAL SCREENING SYMPOSIUM AND WORKSHOP

Educators, school nurses, members of PTA's and civic clubs concerned with sight conservation are invited to attend the First Annual Visual Screening Symposium and Workship, October 10 and 11, at the Walker Memorial Auditorium, University of Florida, Gainesville, it was announced by Dr. Norman H. Rice, Cocoa. Those attending from the educational, nursing, and civic fields will not be requested to pay a registration fee, say co-sponsors of the program: The International Reading Association and the Florida Optometric Association. Optometrists will pay a fee of $15.

Speakers will include: Dr. George Spache, president, International Reading Association and head of the Reading Laboratory and Clinic, University of Florida; Dean Joseph B. White, College of Education, University of Florida; Dr. Charles R. Kelley, senior psychologist, Dunlap and Associates, Inc., Stamford, Conn.; and Dr. Lois B. Bing, Cleveland, Ohio, chairman, American Optometric Association's Committee on Visual Problems of Children and Youth. Dr. W. Judd Chapman, Tallahassee, will serve as Moderator.

Both days will be devoted to a study of the child and his ability to achieve at his present school-grade level; the child who is a slow learner and/or a slow reader, also an investigation into the relationship between the child's vision, his ability to see the printed word, and to get meaning out of what he sees. For further information, write to Dr. Herbert J. Stevens, P.O. Box 466, Gainesville, Florida.

# THE MARK DIPLOPIA FIELD TEST*

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The Mark Diplopia Field Test is a subjective technique for examining the status of the binocular motor apparatus. The devices employed in this test consist of a series of nine stereoscopic-type cards and a stereoscope with which to view the test targets.

When orthoptically handling any case of ocular motor defect the diagnosis of that case becomes paramount. However, a reliable diagnosis can only be established where there is a sound comprehension of those principles which make up modern ocular motility on the clinical level. Many orthoptic cases have resulted in failure simply because the diagnosis in such instances was unsound.

The examiner must understand what it is which constitutes the normal ocular motor apparatus. In this way he is in position to appreciate the anomalous whenever it is encountered. He then evaluates the defect. His orthoptics program should be set up to establish or to re-establish, as the case might be, the normal.

The examiner who demonstrates a poor understanding of the subject of ocular motility is in an adverse position to diagnose or to handle extrinsic muscle problems orthopticly. Some feel that the subject of ocular motility on the clinical level is overemphasized as to its importance to the practice of orthoptics. There can be no doubt that a good background in the subjects of anatomy, physiology, pathologic physiology and neurology of the ocular motor apparatus is indispensable to the diagnosis and treatment of eye muscle problems.

The test to be described here is an attempt to assist the examiner in the diagnosis of the specific paretic or paralysed extrinsic muscle where it exists. Optometrists are well acquainted with the various diplopia field techniques. These tests attempt to pin-point the individual faulty muscle in non-comitant strabismus. No one test has received unanimous acceptance as being the best technique. In general, the diplopia field method allows the examiner to determine where in the binocular field of vision the patient has binocular single vision and

*Read before the annual meeting of the American Academy of Optometry, Section on Orthoptics, Boston, Massachusetts, December 16, 1958. For publication in the September, 1959, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Optometrist. Member of faculty. Fellow, American Academy of Optometry.

where he experiences diplopia. Also, if there is diplopia, where is it greatest. In such tests, an understanding of those muscles which act as agonists, antagonists and yokes becomes important. The examiner wants to know, if there is strabismus, whether it is comitant or non-comitant. If non-comitant, is he dealing with a case of paralysis, paresis or spasm.

In the Mark Diplopia Field Test the patient needs to have, as in all subjective diplopia field tests, simultaneous binocular vision, that is, diplopia or binocular single vision. If there is suppression in one or more diagnostic directions of gaze, and diplopia or binocular single vision in the other directions, this is diagnostic.

Each card of the set of nine has two targets. The targets are 9 mm. vertical arrows. The tip of each arrow points upward. There is one arrow for each eye. The tip of the arrow for the right eye is in contact with a red dot, 2½ mm. in diameter. The red dot is employed for the right arrow. A vertical arrow with its base in contact with a 2½ mm. blue dot is the target for the left eye. Each arrow is vertical so that defects in torsion will cause the patient to observe a tilting of at least one of the doubled arrows.

As stated earlier there are nine testing cards. They are for testing in the following directions of gaze: Primary position, Dextroversion, Up and to the Right, Down and to the Right, Levoversion, Up and to the Left, Down and to the Left, Elevation and Depression. There are only six diagnostic directions of gaze. The card for the primary position is used for setting up the testing distance on the stereoscope. Since elevation and depression are not true diagostic directions of gaze, these two cards are included only for those optometrists who might desire to test in those directions in certain cases.

The targets were designed for the Tel Eye Trainer of Keystone View Company. However, the cards are being constructed for use with most stereoscopes.

The technique is as follows. The patient fits his forehead snugly against the instrument head rest. He is instructed not to move his head, only his eyes. Card number one, Primary Position, is always inserted first in the card holder at the one meter mark on the shaft of the stereoscope. (The one meter distance was selected so that a large number of patients would be able to see the target and therefore, can be tested. Also, accommodation would not be too important an influence.) If the patient can fuse the targets at one meter, all of the other targets are presented to the patient at that distance. However, if there is diplopia, slight adjustments of the card holder along the shaft sometimes assists

certain patients, usually heterophores, to fuse. Where the patient fuses card number one, that position is where the other targets are placed. If diplopia seems to be constant, all cards are inserted at the one meter mark.

Ideally, for each card the patient should see one vertical arrow with a red ball at its point and a blue ball at its base. If there is diplopia with one or more of the test cards, the examiner can tell by the card's title in what direction or directions of gaze there is diplopia. Therefore, he knows what yoke muscles are involved.

A diagnostic chart, Figure 1, has been designed as an aid in record-

DIAGNOSTIC CHART FOR THE MARK DIPLOPIA FIELD TEST

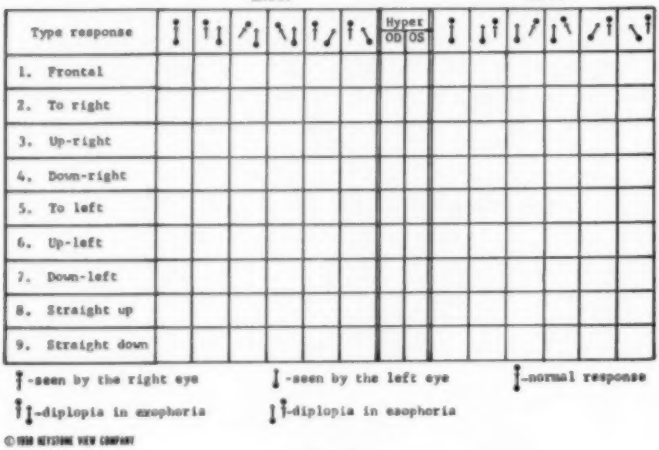


Fig. 1

ing the diagnosis. Each card is represented along the left-hand column of the chart. The main area is divided into Exo and Eso and the subdivisions are headed by the possible responses which the patient might give. There are columns for the Hyper situations when they are encountered. At the bottom of the diagnostic chart are the diagramatic keys to the arrows which are used in the main recording area. As the patient looks at each card and reports his visual experience, the examiner checks that block which represents such an experience. When the patient has been tested on all cards the examiner may, by reviewing the results, determine whether or not there is a faulty muscle or muscles. In many instances he is then in a position to diagnose specifically. Further investigations might be indicated after this diplopia field test is conducted. It

is not to be construed that this test is the final diagnostic word in all cases. No more so than we ignore the importance of perimetry and/or the tangent screen after testing with one of the multiple pattern visual field screeners. The test can be used almost routinely.

One of the important diagnostic assists from this test is the diagnosis of defects of the oblique muscles. This is made by the tilting effect of that image which belongs to the involved eye. Of course some tilt can be caused by a faulty vertical rectus.

To obtain greater degrees of versions, the patient's head is turned in the opposite direction from the position of the targets on the card being used. For example, when dextroversion is tested the targets are well to the right side for each eye. To increase the effect, the patient's head is turned to his left, so long as he can continue to see each target in alternating exposure. Then both eyes are permitted to look at the target simultaneously. (This is after Bielschowsky's recommended technique for examining the versions.)

If there is diplopia in more than one or in all directions of gaze, the examiner can determine where the separation of images is greatest by a process of elimination. For example, if there is diplopia in dextroversion, up and to the right and down and to the right the examiner has the patient compare the distances between images for two directions on the right side. Next, a comparison is made between the direction of the greater separation with the remaining direction of gaze.

If there is a question of which eye is fixating, it can be considered to be the dominant eye where there is binocular single vision. In cases of diplopia the patient can be instructed to look directly at either of the doubled images. That eye is the fixating eye. This latter technique holds where there is no paralysis of a specific muscle.

80 BOYLSTON STREET
BOSTON, MASSACHUSETTS

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ANNOUNCEMENT

SECOND JESSEN-WESLEY PRACTICAL OPTOMETRIC SEMINAR

The second Jessen-Wesley Practical Optometric Seminar will be held on Sunday, October 18, at the La Salle Hotel in Chicago. Twenty-three workshops are scheduled dealing with refractive, orthoptic and contact lens techniques for both optometrists and office assistants. The sessions start at 9:00 A.M.

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AMERICAN JOURNAL OF OPTOMETRY
*and* ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY
Established 1924

Vol. 36 September, 1959 No. 9

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Minneapolis 2, Minnesota

Annual Subscription, United States and Canada, $8.00 in Advance; Foreign, $9.00; Single Copies 80c

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Published Monthly by the
AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION

The American Academy of Optometry and the publishers of this journal have no objection to the reprinting by other magazines of any of the articles in this issue, provided such reprints are properly credited to the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

## A MILITARY OPTOMETRIST REPORTS ON ACADEMY MEETING

It is seldom that one has an opportunity to have a good look at himself through the eyes of someone else.

A determined effort was made last year to obtain as many military people as possible to participate in the annual program of the American Academy of Optometry. We were fortunate in obtaining several outstanding papers from the army, air force, and navy. Among those presenting papers at the Academy was Captain Donald G. Pitts, U.S.A.F. Captain Pitts was so impressed with the caliber of the Academy program that he wrote a complete report of his attendance to his commandant. This report is, of course, slanted for military personnel. His review of the overall program, however, was thought to be of enough general interest that it should be brought to the attention of as many members of the Academy as possible.

SUBJECT: Report on Attendance at a Nonfederal Meeting
TO: COMMANDANT
Air Force Institute of Technology
ATTN: Reports Control Section
Comptroller Branch
Wright-Patterson Air Force Base
Ohio

1. Name of organization, place and date of meeting: American Academy of Optometry, Statler-Hilton Hotel, Boston, Massachusetts, 13-16 December, 1958.

2. The method of presentation of the program was in two divisions: Section Meetings and General Assembly Meetings. The Section Meetings include such areas of interest as Occupational Vision, Contact Lenses and Subnormal Vision, Aniseikonia and Refractive Problems, Orthoptics and Pathology. Each Section holds simultaneous meetings daily from 0900 to 1100 hours; therefore, one must select in advance which daily presentation he is to attend. The General Session met daily from 1100 until 2100 hours except for Monday, 15 December 1958, at 1900 hours when the annual roundtable dinner was held. It was during these General Sessions that contributed papers were read by their authors. Each author was allowed twenty-five minutes for presentation of his paper followed by five-minute question-answer period. The General Sessions were arranged to allow one to attend the reading of every paper scheduled.

3. Fields of interest represented at this meeting were many and varied. They extended from Clinical Optometry, Education, Illumination, Vision in Aviation and analog computers to research problems in Physiological Optics. Each of these fields were directly linked with the application of vision and research in these fields related to vision.

Dr. Sylvester Guth, General Electric Company, Cleveland, Ohio, presented a paper on units of light measurements and concluded with a report of a recent meeting on an International scale on an attempt to resolve some of the terminology confusion that now exists in this field. A published report of this meeting will appear in print in the near future.

Of possible interest to the Air University was an excellent training film which was shown by Cdr. R. L. Vasa, National Naval Medical Center, Bethesda, Maryland, entitled, "*Color Vision Deficiency.*" If the Air Force does not possess such film, it would be excellent for training Flight Surgeon's Techs in the meaning and proper methods of taking color vision. The seriousness of the color deficiency problem to the proper job placement in the service is also stressed.

Leon D. Harmon, Bell Telephone Laboratories, Murray Hill, New Jersey, presented a paper entitled, "*Analogs and Models of the Human Visual System.*" He reviewed work done with analog computers retaining in "memory" the scanning of certain mosaic patterns by a photo-electron tube and the ability of such analogs to reproduce that which was "seen." Dr. Harmon admitted that this research program was only in its infancy and Bell Telephone expected many important applications from it. This system might prove quite useful to military application and bears much deeper study than one could give it from a twenty-five-minute paper. For example, this system might be used to scan a central board from a radar warning system and signal any change according to a preselected set of data fed into the analog "memory."

Of primary interest to myself and other Air Force personnel was the paper entitled, "*Problems of Vision in Aviation,*" presented by T. C. D. Whiteside, Ph.D., M.B., Ch.B., RAF Institute of Aviation Medicine, Farnborough (Hants), England. Dr. Whiteside stated that the problem of vision in aviation depends on the increase of required visual efficiency and increase in aircraft performance in comparison to the use of instruments in the cockpit. Physiological Optics problems at altitude may be due to a change in the physical distribution of light at altitude. Actual brightness of the sky in the stratosphere decreases in direct proportion to the barometric pressure. This is not the same as the present day calculated brightnesses. The absence of clouds at high altitudes increases difficulty of depth perception and ability to see clearly. This is equivalent to Otero's (Spain) "night myopia" and experiments by Campbell (Eng-

land) have shown about 1.00 diopter accommodation proximal to the far point. (In the U.S. we would say 1.00 diopter myopia.) Campbell has also shown "empty field myopia" (Otero's night myopia) is abolished by cycloplegia. (This would indicate the problem is one of the accommodative mechanism.) Experiments done in the air have shown that not only "empty field myopia" but also visual fields and reaction time are affected. All of these problems are interlinked psychophysiologically by such factors as: (1) difficulty in search in an empty field, (2) difficulty in accessing size in an empty field and (3) difficulty in accessing angular motion in an empty field. Experiments by Whiteside to correct this "empty field myopia" have been done and it was found that collimated reticule of 4°—2° on each side of the fovea—was effective. The use of minus lenses was attempted but abandoned when it proved too troublesome to pilots in actual flying conditions. We do not have enough experimental data to draw valid conclusions and recommendations. Much more work must be done in this area because it appears to be a serious problem for high altitude flying and to future space flights. Incidentally, Dr. G. G. Heath, Division of Optometry, Indiana University, has been awarded an Air Force contract to study this problem. It is hoped that I will be able to work with him during the next semester to become more intimately acquainted with this problem as well as some of its possible solutions.

Other important participants were: Thomas H. Eames, Ed.M., M.D., Department of Education, Boston University, Boston, Massachusetts; Dr. Richard Feinberg, Director of Applied Research, Titmus Optical Company, Petersburg, Virginia; H. W. Hofstetter, O.D., Dean, Division of Optometry, Indiana University, Bloomington, Indiana; Kenneth O. Johnson, Ph.D., Executive Secretary, American Speech and Hearing Assn., Washington, D. C.; Glen A. Fry, O.D., Dean, School of Optometry, Ohio State University, Columbus, Ohio; Jay M. Enoch, O.D., Ph.D., Department of Ophthalmology, Washington University Medical School, St. Louis, Mo., and Jack H. Prince, F.B.O.A., F. R. M. S., Institute for Research in Vision, Ohio State University, Columbus, Ohio.

The papers read by the above men were important but conclusions and application to military use was questionable. The list does serve to illustrate the wide scope of interest and various fields of endeavor represented at the Academy meetings.

Worthy of mention is the various papers presented by members of the Armed Forces—especially by Air Force personnel. Since their papers are available to all Air Force personnel a review is not considered necessary but a listing of the paper titles and their authors will be given: *"The Influence of Kenesthesis Upon Near Heterophoria Measurements,"* Major F. M. Morris, USAF(MSC), School of Aviation Medicine, Randolph AFB, Texas; *"The Relationship Between Angle Lambda and the Residual Astigmatism of the Eye,"* Capt. L. R. Loper, USAF(MSC), USAF Hospital, Randolph AFB, Texas; *"Visual Recovery Time for High Intensity Flashes of Light,"* Capt. R. D. Metcalf, USAF(MSC), Aero-Med Lab, Vision Section, Dayton, Ohio, and *"The Transmission of the Visible Spectrum Through the Ocular Media of the Bovine Eye,"* Capt. D. G. Pitts, USAF(MSC), USAFIT, Indiana University, Bloomington, Indiana.

All military papers were well received and well presented. The American Academy of Optometry Executive Council extended a note of appreciation for the participation of the Armed Forces.

4. The meetings of the American Academy of Optometry are non-political in nature and stress the educational program to keep the members abreast of the recent advancements in physiological optics and related fields. It is almost impossible to record on paper the multitude of ideas and concepts one gains from a meeting of this type. Such stimulation of the "thought processes" are essential to sound research principles. One other important phase is in meeting scientists who are laboring in various fields of interest associated with vision. These acquaintances allow one to more easily correspond with certain scientists concerning problems in which you are vitally interested. It is felt that my participation in the program will prove valuable to both the Air Force and myself in the future. The program as a whole was informative, educational and stimulating. It is recommended that the Air University allow its

officers assigned to teaching and research in the field of vision to attend each annual meeting of the Academy of Optometry. This recommendation should be seriously considered whether or not the officer has a paper to present before the Academy General Session.

DONALD G. PITTS
Capt. USAF (MSC)

The attendance at the annual meeting of the Academy has been gradually increasing. This was very obvious at the last annual meeting in Boston where one of our largest registrations and attendance records was in evidence. Far too many members of the Academy do not avail themselves of this excellent opportunity to be brought up to date on the latest research being conducted in our field. The excellent post-graduate program which precedes the Academy is also a necessity for anyone wishing to pursue any of the specialities of his chosen profession.

It is suggested that every Academy member start planning now to attend the Chicago meeting in December of 1959. Each chapter could well spear-head a drive to see that they are represented in some way by as many of its members as possible. The papers mentioned in the excellent report by Captain Pitts could well form the nucleus for a program in each chapter which should also include a discussion of the program for the forthcoming Academy meeting in Chicago.

RALPH E. WICK

## SPECIAL REPORTS

# DEVELOPMENT OF THE ARMY'S OCCUPATIONAL VISION PROGRAM*

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The complete nature of the attention given to improving and maintaining the eyesight of members of the United States Armed Forces needs no dissertation. Not so well known or appreciated, perhaps, is the scope of the industrial health programs for civilian employees of Army installations, especially as applied to vision. Although vision-testing of applicants for civilian employment of the Federal Government

*Read before the annual meeting of the American Academy of Optometry, Boston, Massachusetts, December 13, 1958. For publication in the September, 1959, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometry officer, (Captain) MSC. Chief, Occupational Vision Branch.

has been an accepted procedure for many years, only within the past eight or ten years has emphasis been given to the proper utilization and conservation of eyesight throughout the employment of the individual.

Vision is frequently the basic skill on which most other skills and abilities depend. During World War II production of war materiel was seriously handicapped by lack of attention to eyesight and poor visual conditions among industrial workers. This disturbing fact was brought out by studies made by the National Society for the Prevention of Blindness. Further investigation revealed that subnormal eyesight was keeping 25-40 per cent of war workers below normal production; that inadequate illumination and glare in many factories was handicapping the entire working force; that absenteeism, fatigue, and accident rates were being substantially increased by eye strain; and that protective goggles and other equipment often were not being supplied in sufficient numbers, were not properly fitted, and were not adequately maintained and used. Spot checks of many industries showed that management could realize production gains as high as 25 per cent by constructively attacking the problem of eye strain through the use of corrective spectacles, eye protective glasses or equipment, proper lighting, and job reassignment.

Realizing the need for conservation and utilization of eyesight in industry, the War Production Board on August 19, 1944, issued a letter to American industrial managers offering the services of the War Production Board, the U. S. Public Health Service, the War Manpower Commission, and the U. S. Department of Labor in cooperation with the National Society for Prevention of Blindness to improve "visual-production" conditions. A manual giving specific guidance on the conservation and utilization of eyesight in industry, prepared by the foregoing agencies, and a supply of industrial eyesight appraisal forms accompanied the letter. It was requested that the appropriate officer in each organization check the appraisal forms for guidance in eyesight protection. In line with this program, a series of pilot studies were accomplished also by the Army and Navy to determine the value to the military services of the mass vision-screening instruments in the evaluation of visual capabilities of large groups of individual in a limited amount of time. These studies and the subsequent conferences on industrial vision during 1945 stimulated the evolution of the Army's occupational vision program.

In 1946, personnel of the Army Environmental Health Laboratory became interested in the developments in the industrial vision field. With an ultimate objective of applying the newly developed vision-testing

techniques to all Army installations having an Occupational Health Service, the Army Environmental Health Laboratory initiated small-scale pilot studies using a battery-type vision-screening instrument. Programs in operation at other Governmental and civilian industrial installations were carefully evaluated, and advice and assistance were sought from professional leaders in this field. Operational techniques were developed and stabilized over the next few years.

Surveys were made in Army industrial-type installations such as arsenals and depots to determine eye-hazardous jobs and areas. Authority was obtained for issuance of prescription safety glasses to civilian employees needing correction. Corrective-protective hardened prescription lenses in spectacle-type plastic frames were issued to workers on eye-hazardous jobs. Plano safety glasses were issued by the installation to employees who did not need correction. Eye accidents decreased. One installation saved a substantial amount in the instrument assembly department alone. By the end of 1952, occupational vision programs had been initiated in 19 large Army installations with a total of 90,000 employees.

In 1953 the Office of the Surgeon General, Department of the Army, directed that the Army Environmental Health Laboratory effect the fullest practicable extension of the Occupational Vision Program. Meetings followed between personnel of the Army Environmental Health Laboratory and Preventive Medicine Officers of the Surgeon General's Office, and Preventive Medicine Officers of the six continental Armies which resulted in the agreement on methods to extend occupational vision programs to the maximum extent possible.

In a matter of a few months the response of installations requesting assistance in initiating occupational vision programs was instrumental in more than tripling the number of programs already in effect. By the end of 1954, the occupational vision program had been expanded to include 47 large Army installations and 150,000 employees. During the next year, 19 more installations received an additional health service by initiating occupational vision programs. To date 90 programs, affecting over 200,000 employees, have been initiated and are functioning under the direct supervision of the installation medical facility, with special assistance from the Occupational Vision Branch of the United States Army Environmental Health Laboratory.

There are no basic differences between the vision programs of many large industrial organizations and those in operation at such Army-owned and operated installations as arsenals and depots. The Army program is unique, however, in that specially trained optometrists

visit the installations where, acting in the capacity of consultant, they assist in organizing programs and getting them underway.

Current regulations do not insist that these vision programs be immediately instituted by the medical department of Army installations that employ civilians. However, to initiate an occupational vision program today, any qualified Army installation has only to request the services of the United States Army Environmental Health Laboratory in accordance with procedures outlined in AR 40-557, DA, Washington 25, D. C., 19 November 1956, Medical Service, Occupational Health Service of the Army. This Army Directive prescribes the scope and objectives of occupational health service programs and outlines the procedures for accomplishing these objectives. Once the installation has requested the assistance of the Laboratory in establishing a vision program, arrangements are made for a representative of the Occupational Vision Branch to visit the installation for approximately one week.

The post surgeon or industrial physician will be, in most instances, responsible for directing the program. As in civilian industry, a vision program in the Army will not succeed without the combined efforts of command, medical and safety departments, and key personnel. To assure the effective utilization and preservation of eyesight, the United States Army Environmental Health Laboratory believes the following objectives must be achieved:

a. Analysis of jobs for vision standards.

b. Special vision-screening of all personnel to determine their visual abilities and defects.

c. Refracting and prescribing for the correction of visual defects affecting job performance.

d. Care of eye injuries and diseases.

e. Determination of eye-hazardous jobs.

f. Supervision of eye protection and eye hygiene.

g. Promotion of proper lighting.

h. Indoctrination and education of employees.

The primary duties or responsibilities of the various services or offices within an organization in carrying out a successful occupational vision program are as follows:

MEDICAL SERVICE

(1) Conducts a complete inventory of all work activities, analyzing each job to determine visual requirements. These jobs are classified under one of six broad vision standards which represent the degree of visual skill required for efficient job performance.

(2) Screens the vision of all personnel normally every two years, or more often, when required as in the case of motor vehicle operators

who are screened annually.

(3) Determines whether the personnel screened meet the vision standards for their particular jobs.

(4) Refers civilian employees who fail to meet the vision standard for professional eye examination at their own expense.

(5) Refers military personnel who fail to meet the vision standard for professional eye examination to a military medical facility.

(6) Checks for accuracy all prescriptions for safety glasses.

(7) Insures proper fitting of all safety glasses.

(8) Maintains files of vision record cards and prescriptions with individual's medical record.

(9) Announces to the professional men in the community the initiation of an occupational vision program.

SAFETY OFFICER

(1) Conducts a preliminary survey to determine which jobs and areas are to be classified as eye-hazardous.

(2) Designates, in coordination with the Medical Service and Supervisor, the correct type of protective eyewear required for an employee exposed to various eye hazards.

(3) Monitors the protective phase of the program, making recommendations (cleaning stations, posters, signs) for improvement when applicable.

PERSONNEL OFFICE

(1) Prepares the job-title list to be used in the survey by the Medical Service and Safety Office.

(2) Schedules personnel for vision-screening in coordination with supervisors and medical department.

(3) Utilizes the job-vision standards as an aid to the employee-utilization program of the installation.

PURCHASING AND CONTRACT OFFICE

Negotiates contracts for the purchase of plano and prescription safety eyewear and for maintenance when necessary.

DIVISION AND BRANCH HEADS AND OTHER SUPERVISORS

(1) Coordinate with the Medical Service the scheduling of employees to be screened.

(2) Assist the Medical Service and Safety Office in selecting the type of protective eyewear for various eye-hazardous jobs.

(3) Make certain that employees are not placed on eye-hazardous jobs without proper protection.

(4) Obtain and keep a stock of plano safety glasses and protective eyewear, in coordination with the installation Property Office.

(5) Procure, post, and maintain signs and posters stressing eye safety.

(6) Direct all personnel having visual difficulties or complaints from the use of safety glasses, to the medical service.

(7) Enforce safety discipline and the wearing of safety eye protection.

(8) Point out to new personnel the benefits of adequate vision.

PROPERTY DISPOSAL OFFICE

Determines the value of the prescription-ground safety glasses, upon termination of employment of an employee desiring to retain such glasses, and sells them to the employee in accordance with existing Army Regulations.

The occupational vision consultant of the United States Army Environmental Health Laboratory, during his week's visit at an installation, assists command, Medical Director, Safety Officer and the key personnel in organizing and establishing the occupational vision program. The initial survey to analyze the jobs for vision standards and eye protection is performed by this officer with the assistance of the medical and safety officers. Lighting conditions and any matter relating to visual conditions or eye safety, such as color dynamics or eye lavage facilities where acid splash may be encountered, are inspected and recommendations made accordingly.

A vision-screening instrument is furnished to the post. The consultant services of the United States Army Environmental Health Laboratory are available to installations requesting a vision program. This arrangement has been necessary because of the importance of careful supervision and orientation in the initiation period of an occupational vision program, and the limited number of specialists available from the Occupational Vision Branch of the Laboratory.

The Medical Director and the nurses or medical technicians are thoroughly trained in the operation and use of the screening instrument. At the close of each testing day the technician compares the scores with the job vision standards assigned by the consultant. Notification forms are completed for those employees obviously passing or failing: the borderline or exceptional cases are referred to the chief medical officer or industrial physician for individual evaluation. An employee who needs corrective safety eyewear is given a prescription blank to take to his eye doctor for completion of the prescription and frame measurements. The prescription is returned to the medical department for review, then forwarded to the safety office where the proper type of eye protection is specified and ultimately forwarded to the installation purchasing

authority. The refraction is the financial responsibility of the employee. The law provides for emergency eye treatment only, except for occupationally incurred disease or injury.

When the United States Army Environmental Health Laboratory representative leaves an installation the occupational vision program is already operating. Periodic visits are made subsequently to all installations having vision programs to assist in solving operational and administrative problems that may have arisen.

The operation of occupational vision programs varies somewhat between Army installations depending on availability of personnel to carry on the activity, and the policies and needs of individual installations. In an undertaking as far-flung and diversified as the industrial interest of the Department of the Army, it is neither feasible nor desirable to attempt centralized control or exact uniformity. All occupational vision programs, however, are operated under the general guidance and with the assistance of the United States Army Environmental Health Laboratory which insures a reasonable degree of uniformity between programs.

As an example of the effective operation of occupational vision programs, one Army installation estimates it has saved approximately $100,000 in compensation cost since the initiation of the program three years ago. During that time 10,000 persons were screened, and 300 prescription-ground safety glasses and 900 plano safety glasses were issued. Two years prior to the initiation of the program, there had been an average of six disabling eye injuries per year. In the three years that the program has been in operation, there have been two disabling eye injuries per year. Evidenced by cracked safety lenses, ten employees avoided potential eye injuries or loss by the conscientious wearing of safety glasses.

In the not too distant future, as development of the occupational vision program continues, it is hoped that all employees of Army industry will be receiving the benefits of this service. The day this goal is achieved will be a memorable one for the Army's Occupational Health Service and for those persons whose sight has been saved as a direct result of this program.

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## NOTES ON OPTOMETRIC MANPOWER*

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The profession of optometry has to face the problem of subnormal enrollments in its colleges. This problem has persisted for the past six or seven years (Table I) and apparently will continue to trouble us for at least several more years. The situation of having too few students in our colleges of optometry produces two detrimental effects on the profession. First, when an insufficient number of new practitioners enter the field, a certain proportion of the demand by the public for optometric services must remain unfilled. This invites a competitive profession to supply the demand with an increase in its personnel in the eye care field. Second, when the colleges of optometry have low student enrollments, they must operate below their optimum capacities of physical facilities, faculty, etc., thereby raising the per student cost and reducing the efficiency of operation. These detrimental effects are real and serious. They retard the growth and development of the profession and present a real danger to its continued existence. Is the profession retrogressing? The extent and degree of damage to the profession by the lack of normal enrollments is hard to access with any great accuracy. The pessimist sees the situation as the "beginning of the end" of the profession. The writer does not share this viewpoint but still recognizes fully the seriousness of the problem. Some observations can be made and certain questions posed, but no quick decisive solution can be offered.

How bad is the problem from the standpoint of optometry's ability to continue to supply the public's demand for its services? The fact has been pointed out in optometric publications that there are fewer persons in the United States holding optometric licenses at this time than in

*Read before the Vocational Guidance Planning Conference of the American Optometric Association, Charlotte, North Carolina, August 2, 1959. For publication in the September, 1959, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Optometrist, Dean of College, Fellow, American Academy of Optometry.

TABLE I.

Enrollment and Graduation Summary
1940-41 through 1958-59

| School Academic Year | Number of Accredited Shools | | Total Enrollment | Total of Optometric Graduates for Year |
|---|---|---|---|---|
| 1940-41 | 8* | | 1564 | 373 |
| 1941-42 | 8 | | 1309 | 418 |
| 1942-43 | 8 | | 1154 | 336 |
| 1943-44 | 8 | | 648 | 325 |
| 1944-45 | 8 | | 657 | 157 |
| 1945-46 | 8 | | 818 | 217 |
| 1946-47 | 9 | (Pacific added) | 2234 | 528 |
| 1947-48 | 9 | | 4278 | 1452 |
| 1948-49 | 10 | (Chicago added) | 4350 | 1934 |
| 1949-50 | 10 | | 3268 | 1572 |
| 1950-51 | 10 | | 2435 | 961 |
| 1951-52 | 10 | | 2015 | 636 |
| 1952-53 | 11 | (Houston added) | 1959 | 684 |
| 1953-54 | 12 | (Indiana added) | 1631 | 674 |
| 1954-55 | 12 | | 1396 | 473 |
| 1955-56 | 11 | (Illinois & Chicago merged) | 1233 | 333 |
| 1956-57 | 10 | (Columbia discontinued) | 1175 | 355 |
| 1957-58 | 11 | (Ontario added) | 1177 | 358 |
| 1958-59 | 11 | | 1178 | (not available) |

*The original list of accredited schools and colleges included the following: Northern Illinois College of Optometry; The School of Optometry, The Ohio State University; The School of Optometry, University of California; The Pennsylvania State College of Optometry; The School of Optometry, Columbia University; Los Angeles College of Optometry; Massachusetts College of Optometry and Southern College of Optometry.

earlier years. I agree that this does not look too good. But, even though we have experienced a decline in the number of licensed optometrists, there is some doubt that we have less practitioners available to the public. Because of the recency of the enactment of optometry regulatory acts (1924 being the latest) and the ease of obtaining licenses at the time of passage of these acts, many persons have been listed as optometrists in the past who either engaged in no optometric practice at all or engaged in only part time practice. The more recent licensees have been inclined to devote their full time to optometric practice exclusively. Also, we had a relative oversupply of new practitioners for several years following World War II. Does the present shortage neutralize a previous oversupply or is it leaving us with a net deficiency? There is no yardstick with which to make an objective measurement. I pose the question without an attempt to answer it. However, recent studies of the relationship of population to the number of eye care practitioners in the large cities would seem to show no shortage of supply of either optometrists or medical eye practitioners. These studies show just the opposite. The relative oversupply of practitioners in the large cities results in

unsound economic conditions for these practitioners and may be considered safely as one significant factor in hindering enrollment in optometry colleges. Over the years a large portion of the enrollments of our colleges come from the larger cities and mostly through the recommendations of practitioners. Can one expect dissatisfied practitioners to encourage young people to enter optometry? It might be well to point out in passing that some of the overall sociological changes which have taken place in our large cities have plagued the large city practitioners, such as the trend to suburbia of the higher income families and the development of shopping and service facilities on the periphery of the cities. The public living in the surrounding areas does not go to the cities for eye care services as it was accustomed to do in years gone by. Should the American Optometric Association concern itself specifically with the problems of the optometrists of the large cities? Is there some project in which the A.O.A. could engage which would aleviate the problems of these optometrists? Can only slow-moving evolutionary changes remedy this condition? Again, no answer is attempted.

One factor, the large city problem, which hinders optometry enrollments has been pointed out, but the writer does not consider this to be the most important factor, even though it is mentioned first. A review of birth data, Table II, and of first year enrollments, Table III, in our colleges of arts and science for the past eight years would

TABLE II.

Births in the United States
1930 through 1953

| | | | | | |
|---|---|---|---|---|---|
| 1930 | 2,203,958 | 1938 | 2,286,962 | 1946 | 3,288,672 |
| 1931 | 2,112,760 | 1939 | 2,265,588 | 1947 | 3,699,940 |
| 1932 | 2,074,042 | 1940 | 2,360,399 | 1948 | 3,535,068 |
| 1933 | 2,081,226 | 1941 | 2,513,427 | 1949 | 3,559,529 |
| 1934 | 2,167,636 | 1942 | 2,808,996 | 1950 | 3,554,147 |
| 1935 | 2,155,105 | 1943 | 2,934,860 | 1951 | 3,648,954 |
| 1936 | 2,144,790 | 1944 | 2,794,800 | 1952 | 3,839,490 |
| 1937 | 2,203,337 | 1945 | 2,735,456 | 1953 | 3,909,000 |

seem to show that a short supply of potential students is the key factor. Optometry is dependent primarily on white males for its students. The percentages of all females and of male negroes in optometry are so small that data relating to number in these categories as potential optometry students may be ignored in assessing our situation.

If we go beyond the influx of students in all fields of higher education after World War II, we find that the first year college enrollments in the arts and science colleges declined earlier than did enrollments in optometry colleges. This occurred because the general colleges depend on enrollments of high school graduates, and these were few as the

TABLE III.
Enrollment of First Time Students
1946-47 through 1958-59

| (Fall) Year | Total | Men | Women |
|---|---|---|---|
| 1946-47 | 696,419 | 499,532 | 196,887 |
| 1947-48 | 592-846 | 399,972 | 192,874 |
| 1948-49 | 568,768 | 369,924 | 198,844 |
| 1949-50 | 557,856 | 357,265 | 200,591 |
| 1950-51 | 516,836 | 319,733 | 197,103 |
| 1951-52 | 472,025 | 280,277 | 191,748 |
| 1952-53 | 536,879 | 323,673 | 213,206 |
| 1953-54 | 571,533 | 344,844 | 226,689 |
| 1954-55 | 642,420 | 396,234 | 246,186 |
| 1955-56 | 689,635 | 430,579 | 259,056 |
| 1956-57 | 723,000 | 446,000 | 277,000 |
| 1957-58 | 729,725 | 445,324 | 284,401 |
| 1958-59 | 781,075 | 468,625 | 312,450 |

result of the low number of births during the depression years of the 1930's. If the percentage of high school graduates entering fields of higher education had not increased over previous years, the decline would have been very spectacular. Actually, the increase in the percentage of high school graduates attending college is accounted for to a large degree by an increase in the female enrollment, an increase which is of little or no help to optometry enrollments. The relationship between total enrollments in higher education and first year enrollments in colleges, Table IV, has changed greatly over the years and tends to confuse an analysis of optometry's enrollment problem in relation to the general enrollment situation. The proportion of college students enrolled in graduate curricula and in part time programs is now larger than ever before. Likely, this fact may be explained to a considerable degree by the operation of educational plans in industry

TABLE IV.
Total Enrollments
1946-47 thru 1958-59

| (Fall) Year | Total | Men | Women |
|---|---|---|---|
| 1946-47 | 2,078,095 | 1,417,595 | 660,500 |
| 1947-48 | 2,338,226 | 1,659,249 | 678,977 |
| 1948-49 | 2,408,249 | 1,712,283 | 695,966 |
| 1949-50 | 2,456,841 | 1,728,672 | 728,169 |
| 1950-51 | 2,296,592 | 1,569,322 | 727,270 |
| 1951-52 | 2,116,440 | 1,398,735 | 717,705 |
| 1952-53 | 2,148,284 | 1,387,094 | 761,190 |
| 1953-54 | 2,250,701 | 1,432,474 | 818,227 |
| 1954-55 | 2,499,750 | 1,601,984 | 897,766 |
| 1955-56 | 2,720,929 | 1,784,158 | 936,771 |
| 1956-57 | 2,947,000 | 1,928,000 | 1,019,000 |
| 1957-58 | 3,068,417 | 2,003,424 | 1,064,993 |
| 1958-59 | 3,258,556 | 2,110,426 | 1,148,130 |

which offer time off and often tuition payments to employees who pursue advanced courses in the employee's field of specialization and by the educational policy of the public schools which provide salary incentives to teachers for obtaining additional credits in higher education. Reports of large enrollments in higher education in contrast to optometry's subnormal enrollments tend to create apprehension in the mind of the casually observing optometrist.

Another observation which seems worthy of note is that optometry is not unique in its problem of subnormal enrollments. All the health professions have experienced a decrease of applicants for enrollment. The decrease for chiropody has been so severe that Temple University in Philadelphia has discontinued its School of Chiropody. Between the years 1949-50 and 1954-55, the American medical colleges experienced a gradual decrease in the number of applicants from 24,434 to 14,538, a decrease of forty per cent. Table V. The following two years, 1956 and 1957, show a small but rather insignificant increase in the number of medical school applicants.

Another contributing factor to our enrollment problem, although probably not very significant, is the increasing length and cost of the instructional program in optometry. Still another factor is the competition for students, not only with the other health profession but also with all vocations requiring higher education. Coupled with this competition, optometry has had less student financial aid and other incentives to offer prospective students than most of the colleges of graduate and professional caliber.

Optometry has lacked positive student recruitment programs, such as that of the teaching, the engineering and the other professions. This statement is made without criticism of anyone or of any organization, for it is obvious that any recruitment program requires man power and money, both of which are necessarily limited in a professional group the size of Optometry.

It would seem to the writer on the basis of his experience with student admissions that any student recruitment program must enlist the aid of the practitioners. In periods of both plenty and paucity of applicants, a larger percentage of the students who apply have become interested in optometry through practitioners than through all other sources combined. The unsatisfactory status of the large city optometrist has been mentioned. There is a widespread but decreasing attitude among optometrists that it is unwise for them to promote interest in optometry as a career for fear of producing an oversupply of new practitioners. This attitude is generally justified by some optometrists who

TABLE V.
APPENDIX - E
Number of Medical School Applicants
1949-50 through 1956-57

| Year | Applicants | Year | Applicants |
|---|---|---|---|
| 1949-50 | 24,434 | 1953-54 | 14,678 |
| 1950-51 | 22,279 | 1954-55 | 14,538 |
| 1951-52 | 19,920 | 1955-56 | 14,937 |
| 1952-53 | 16,763 | 1956-57 | 15,917 |

point to the overcrowding which took place in certain optometry colleges following World War II. As a first step in getting the cooperation of practitioners, it might be well for the Council on Optometric Education to provide accreditation of optometry colleges with a realistic limit on the size of entering classes. This accreditation should be based on the college's facilities, with the understanding that the size of entering classes may be increased only by prior agreement with the Council. Optometry college's can never get too many applications, but they can have too many students. Assurance to the profession that there will not be overcrowding of colleges in the future should be helpful in enlisting the aid of the practitioners.

It is the writer's opinion that enrollments in optometry colleges will start a significant upward climb in 1960. Left to fortuitous factors the climb will be gradual, too gradual for the good health of the profession. Positive action is desirable and needed to accelerate the increase of optometry college enrollments. If man power and money were not limited, there is no doubt that most any goal of student recruitment could be reached. It seems to the writer that certain decisions must be made as to what among many possible approaches we should select, what methods with our limited man power and money available will be the most effective in attracting optometry students. We must forego the opportunity of utilizing numerous possible programs because of a lack of the resources to carry them out. Certainly, through a student recruitment program tailored to the resources we have, we can accomplish enough to speed up the natural increase in enrollments about to take place. If we start our program now or in the very near future, we should be able to restore enrollments and our profession to a healthy state within the next five or six years.

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## TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

### KEEPING ABREAST

The full impact of modern scientific achievements now is becoming evident. Remarkable discoveries are reported almost daily as man probes deep inside the atom, to the edge of the universe, inside the cell, or outside the atmosphere. Today, unlike any other period in history, scientific research is accepted as a necessity in our way of life and widespread support is manifest. As a result of these efforts, scientific frontiers are rapidly expanding; these developments certainly are laudable and very desirable but they pose a serious problem not only for the individual optometrist but for the profession as a whole.

For example—consider contact lenses. The developments in this field alone have been so rapid and numerous that unless one is actively engaged in this type of work and makes a consistent effort to keep abreast of developments, one easily becomes overwhelmed. The same impact is evident in the care and aid of the partially blind, visual training, refraction, practice management and economics, etc. Fortunately there are means to aid the practitioner to master these situations and one of these is the program of the annual meeting of the American Academy of Optometry. These courses are open to all optometrists.

This year marks the fifth consecutive year for the post graduate courses of the Academy. During this time the same pattern for the courses has been followed, i.e., all the courses are short in duration with the majority not exceeding two hours in length; the instructors in the courses are recognized authorities in specialized fields of endeavor; the courses are consecutive and limited to the first three days of the regular annual meeting of the Academy; practical as well as theoretical courses are included in the program to meet varying needs of practitioners; and the cost is kept to a minimum.

The complete program of the courses this year was presented in the August issue of this Journal and a summary of the courses is included in this number. Consequently, it only is necessary to emphasize several important aspects of the courses not presented elsewhere. Roughly, the courses are divided into six groups on the basis of subject matter: Refraction, orthoptics and vision training, practice management and

economics, pathology and diseases of the eyes, contact lenses and subnormal vision and blindness. The courses in the different areas as well as the instructors and length in hours of instruction are as follows:

## Refraction

| Subject | Instructor | Length (hours) |
|---|---|---|
| Subjective & Objective Refractive Instruments | Allen | 1 |
| Streak Retinoscopy | Copeland | 4 |
| New Trends in Dispensing | Dowaliby | 2 |
| Plastic Lenses and Their Clinical Application | Dowaliby | 1 |
| Visual Acuity Charts | Eastman | 1 |
| Evaluation of Quality in Ophthalmic Lenses | Fry | 1 |
| Vision Discomfort — Role of Glare Sources and the Pupil | Fry | 1 |
| Recent Advances — Illumination and Lighting Design | Guth | 2 |
| Stigmatoscopy | Heath | 1 |
| Office Use of the Haploscope | Heath | 2 |
| Supplementary Methods of Investigating Heterophorias | Hebbard | 1 |
| Refractive Changes throughout Life | Hirsch | 2 |
| Binocular Nearpoint Testing Technique | Jaques | 1 |
| Care and Adjustment of Ophthalmic Instruments | Jobe | 2 |
| Analysis and Use of Blended Bifocals | Knoll | 1 |
| Use of Fresnel Lenses for Magnification | Knoll | 1 |
| Turville Infinity Balance Test | Morgan | 2 |
| Principles of Aniseikonic Correction | Rayner | 2 |
| Design of Aniseikonic Corrections | Rayner | 2 |
| Monocular Occlusion Testing | Roy | 2 |
| Accommodation and Refractive Errors | Westheimer | 2 |

## Orthoptics and Vision Training

| Subject | Instructor | Length (hours) |
|---|---|---|
| Visual Training and Speed Reading | Anapole | 6 |
| Diagnosis of Amblyopia and Central Scotomata | Kratz | 2 |
| Bangerter Technique for Training Amblyopia | Morgan | 3 |
| Optometrists Relationship to the Reading Program | Rosenbloom & Robinson | 4 |

## Practice Management and Economics

| Subject | Instructor | Length (hours) |
|---|---|---|
| Accounting and Office Procedures | Bebber | 2 |
| Practice Management | Dick | 2 |
| Accounts Receivable Control | Dick | 1 |
| Legal Aspects of Practice | Ott | 2 |
| Partnerships, Associateships and Transfer of Practices | Ott | 2 |

## Pathology and Diseases of the Eyes

| Subject | Instructor | Length (hours) |
|---|---|---|
| Entoptic Phenomena | Allen | 2 |
| Theory and Practice of Tonometry | Carter | 2 |
| Ocular Manifestations of Systemic Diseases | Grosvenor | 2 |
| Visual Fields with Multi-pattern Test Targets | Hebbard | 1 |
| Flicker Fusion | Hebbard | 1 |
| Recent Advances — Ocular Anatomy and Neurology | Jankiewicz | 2 |
| Microbiology in Contact Lens Practice | Jankiewicz | 2 |
| Ocular Pathology Review | Shlaifer | 4 |
| Hypertensive and Arteriosclerotic Retinopathies | Simmerman | 2 |
| Early Detection of Pathology | Talcott | 2 |

## Contact Lenses

| Subject | Instructor | Length (hours) |
|---|---|---|
| Accommodation and Convergence with Contact Lenses | Firestone | 2 |
| Advanced Course on Corneal Lenses | Graham, Feinbloom & Dickinson | 8 |
| Slit Lamp Microscopy in Contact Lens Practice | Mazow | 6 |
| The Pupilens | Mazow | 1 |
| Corneal Contours in Contact Lens Practice | Harold Moss | 2 |
| Astigmatism and Contact Lenses | Harold Moss | 1 |
| Contact Lens Records, Forms and Routine | Herbert Moss | 1 |
| Cosmetic Contact Lenses | Herbert Moss | 1 |
| Microbiology in Contact Lens Practice | Jankiewicz | 2 |
| Technique of Microlens Fitting | Neill, Dickinson & Associates | 12 |
| Adjustment and Modification of Contact Lenses | Policoff | 6 |
| Comparison of Corneal Lenses | Stewart | 2 |

## Subnormal Vision and Blindness

| Subject | Instructor | Length (hours) |
|---|---|---|
| Fundamentals of Aspheric Lenses | Davis | 2 |
| Subnormal Vision and Clinic | Feinbloom, Filderman & Williams | 6 |
| Physiological Optics of the Partially Blind Eye | Feinbloom | 2 |
| Fresnel Lenses for Magnification | Knoll | 1 |
| Subnormal Vision | Rosenbloom & Policoff | 4 |

The tremendous opportunity from such a wide selection of courses now should be apparent. In the development of this program as well as its presentation next December 9, 10 and 11 at the Drake Hotel in Chicago, the instructors manifest their willingness to share with you their knowledge of modern, scientific optometry. The choice is yours and it is our hope that you choose to "keep abreast."

For a free, 12 page, booklet reviewing each of these 64 courses and the time schedule for them, write to Dr. D. G. Hummel, 1318 National City Bank Bldg., Cleveland 14, Ohio. This special course material will also be found in the August, 1959, issue of this publication, pages 439-448.

V. J. ELLERBROCK, Chairman

COMMITTEE ON INSTRUCTION
ACADEMY POST-GRADUATE COURSES

# CURRENT COMMENTS

Terry Judith Parkins
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

## BRITISH CHAPTER — AMERICAN ACADEMY OF OPTOMETRY

One of the most successful meetings the British Chapter of the American Academy of Optometry has held during the nine years it has been in existence was the June, 1959, meeting, at which Mr. Leonard Lurie, the eminent ophthalmic surgeon, gave an illustrated lecture on his new technique of cataract extraction.

The meeting was held in the panelled eighteenth-century lecture theatre of the Medical Society of London, Chandos Street, W.1. About seventy members and guests were present, including the twenty-three students from nine different countries who were attending the London Course of Optometry, among them being Miss Viktoria Tribusson of Yugoslavia, the recipient of the £25 bursary awarded by the AAO British Chapter. In the chair was Mr. Euin Steele, who opened the meeting by calling upon the audience to stand in silence in memory of Captain Joseph Curry, an optometrist with the U. S. Air Force in England, who had died following an accident a few days before.

Mr. Lurie began his lecture with an historical survey of cataract extraction and couching, beginning with the days when treatment consisted of thrusting through the limbus a needle plucked from the operator's robe and dislodging the opaque crystalline lens into the vitreous chamber, and ending with Mr. Lurie's own technique developed over the past few years. Essentially this consists of injecting into the ciliary region of the eyeball an enzyme which softens by partial "digestion" the fibres of the zonule of Zinn and so enables the surgeon more easily to detach the lens and spoon it out intact in its capsule through an iridectomy and corneal flap.

Mr. Lurie then projected a colour film which showed with remarkable clarity a series of operations of this type which he had successfully carried out. Each stage was illustrated, from the insertion of the first eyeball-steadying sutures to the removal of the dressings a few days after the operation.

A vote of thanks was moved by Mr. C. S. Flick, who paid tribute to Mr. Lurie as one of those ophthalmic surgeons who without waiting for statutory registration or official recognition of British ophthalmic

opticians had always been ready and willing to assist them by lectures and in other ways to improve and enlarge their knowledge. The value of the lecture and the film lay not only in its intrinsic interest, but by showing what the surgeon did it enabled us more intelligently to do our subsequent work of refracting, prescribing and fitting spectacles for post-cataract cases.

The British Chapter of the A.A.O., which is steadily growing in numbers and prestige, is to be congratulated upon the success of this meeting, upon its continued efforts on behalf of optometric education and the example of high professional status and practice which it sets.

## OPTOMETRIC DUTIES IN CALIFORNIA CIVIL DEFENSE INCREASED

The California Disaster Office has revised and increased the duties of optometrists in the civil defense program of the Golden State. Bulletin No. 41, Revision #1, issued July 15, 1959, by Director H. G. Robinson, outlines the added assignments as follows:

"There will be a time immediately following an attack when First-Aid Stations will need all the trained help they can get. With this in mind the duties of optometrists should be divided into two phases as follows: *Phase I* — For the first 48-72 hours, or as long as needed, optometrists should be assigned, from the mobilization centers where they have registered, to First-Aid Stations to assist in care of eye and facial injuries. *Phase II* — Those not employed as outlined in Phase I, and those being released from this assignment, will establish visual care stations under the direction of the local or operational area Medical Chief. These visual care stations are places where persons can have their eyes refracted and receive either corrective glasses or prescriptions to be presented to optical supply companies for filling."

Under the terms of paragraph 6 of the bulletin each Regional Coordinator, upon recommendation of his Medical Chiefs, will designate an optometrist as assistant to his Medical Chief for optometry.

One optometrist on each of the three eight-hour shifts at the visual care stations will be in charge of the station itself.

## NEWS BRIEFS

As a public service, American Optical Company is offering at no charge, reprints of the comprehensive article on spectacles which was featured in the April issue of GOOD HOUSEKEEPING MAGAZINE. Entitled *The Risks You Run With Cheap Eyeglasses*, the reprint is in statement insert size and contains no advertising matter. Imprinting can be had on inserts at a nominal charge of $3.00 per thousand. They may be obtained through any AO Franchised Distributor or AO Branch office.

# Monocular Aphakia

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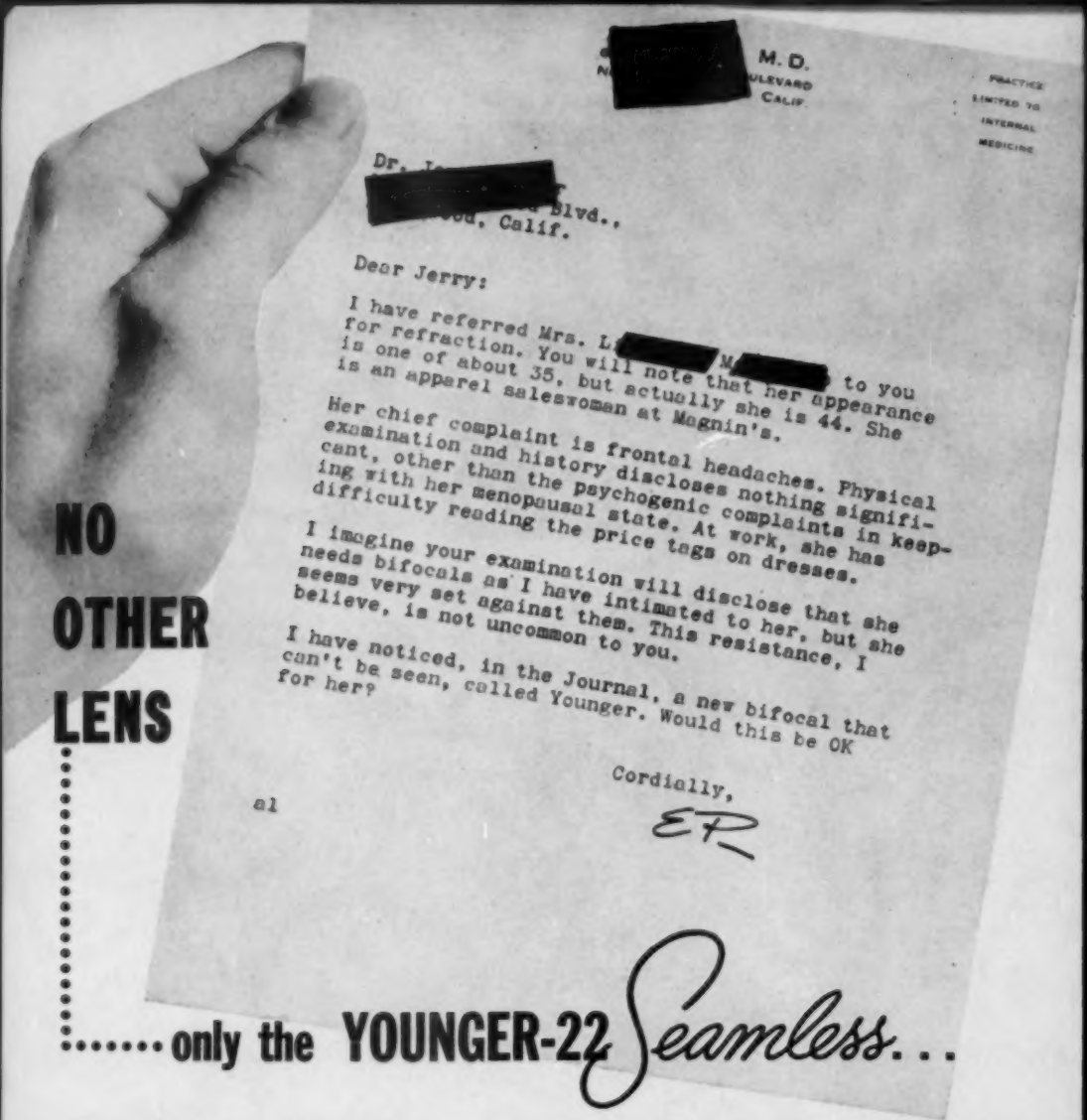
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Dear Jerry:
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Her chief complaint is frontal headaches. Physical examination and history discloses nothing significant, other than the psychogenic complaints in keeping with her menopausal state. At work, she has difficulty reading the price tags on dresses.
I imagine your examination will disclose that she needs bifocals as I have intimated to her, but she seems very set against them. This resistance, I believe, is not uncommon to you.
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